



# 2018 Annual Groundwater Report

---

## CCR Surface Impoundment System

### James DeYoung Power Plant

### Holland Board of Public Works

Holland, Michigan

---

January 31, 2017

(Revised March 13, 2018)

NTH Project No. 73-160017-04

NTH Consultants, Ltd.  
41780 Six Mile Road, Suite 200  
Northville, MI 48168





## **Revision Log**

### ***Revision 1 – March 13, 2018***

- Section 4.4 - Groundwater Sample Analysis and Data Evaluation, and Appendix C (Summary Table of Analytical Results and Groundwater Analytical Results) of this “2018 Annual Groundwater Report – CCR Surface Impoundment System,” were revised to include laboratory analytical report and pertinent discussion for radiological data (Radium 226 and Radium 228) and results for samples collected on January 10, 2018.



## TABLE OF CONTENTS

<b>1.0</b>	<b>INTRODUCTION .....</b>	<b>1</b>
<b>2.0</b>	<b>PURPOSE AND OBJECTIVES.....</b>	<b>1</b>
<b>3.0</b>	<b>STATUS OF THE GROUNDWATER MONITORING PROGRAM.....</b>	<b>2</b>
<b>4.0</b>	<b>ACTIONS COMPLETED .....</b>	<b>3</b>
4.1	Development of Sampling and Analysis Plan .....	3
4.2	Update to Groundwater Monitoring System.....	3
4.3	Groundwater Sample Collection.....	4
4.4	Groundwater Sample Analysis and Data Evaluation.....	6
<b>5.0</b>	<b>PROBLEMS ENCOUNTERED .....</b>	<b>8</b>
<b>6.0</b>	<b>ACTIONS TO RESOLVE THE PROBLEM.....</b>	<b>8</b>
<b>7.0</b>	<b>KEY ACTIVITIES FOR THE UPCOMING YEAR .....</b>	<b>8</b>
<b>8.0</b>	<b>RECORDKEEPING, NOTIFICATION, AND POSTING TO THE INTERNET .....</b>	<b>9</b>

## APPENDICES

### FIGURES

- Figure 1 – Site Location Plan
- Figure 2 – Monitoring Well Location Map
- Figure 3 – Groundwater Flow Map

### APPENDIX A

### WELL BORING AND INSTALLATION LOGS

### APPENDIX B

### GROUNDWATER SAMPLING DATA

### APPENDIX C

- Summary Table of Analytical Results
- Groundwater Analytical Results
- Groundwater Sampling Collection Logs



## **1.0 INTRODUCTION**

Holland Board of Public Works (BPW) owns and operates the James DeYoung (JDY) power plant located in Holland, Michigan, on the eastern end of Lake Macatawa. JDY was initially built in 1939 with a generating capacity of 15 megawatts (MW). Between 1953 and 1968, three new boilers were added. From the late 1970's to the early 2000's, the plant consisted of three coal-fired boilers capable of producing up to 62.5 MW. On May 20, 2016, BPW discontinued the use of Unit 3; and on June 1, 2017, BPW officially shutdown and retired all generation units at JDY. When Units 3-5 were operating, bottom ash from these boilers was sluiced to the first of three surface impoundments located to the south of the plant, as shown on Figure 1 (Appendix A). These surface impoundments became subject to 40 CFR Part 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals (CCR) in Landfills and Surface Impoundments upon promulgation on April 17, 2015.

## **2.0 PURPOSE AND OBJECTIVES**

Groundwater monitoring and corrective action requirements for existing CCR units are contained in 40 CFR §257.90 through §257.98. 40 CFR Part §257.90 (e) establishes the requirement to prepare an initial annual groundwater monitoring and corrective action report. Consistent with this requirement, this report:

- documents the status of the groundwater monitoring and corrective action program for the CCR unit,
- summarizes actions completed,
- describes problems encountered,
- discusses actions to resolve the problems, and
- describes key activities for the upcoming year.



### **3.0 STATUS OF THE GROUNDWATER MONITORING PROGRAM**

A limited hydrogeological investigation work plan was developed for the site in 2009 that established a groundwater detection monitoring program to address the requirements of Michigan Administrative Code R 323.2237(4) of Michigan's Natural Resources and Environmental Protection Act, 1994 Public Act 451, as amended (Act 451). The work plan pre-dated the final federal CCR rules and had the purpose of satisfying a request by Michigan Department of Environmental Quality to determine whether the presence of bottom ash lagoons (CCR units) may have affected groundwater quality in the surrounding area. The results of this investigation were inconclusive and additional investigative activities were merited.

In 2011, BPW completed subsequent investigation activities at the Site, including the installation of additional monitoring wells, collection of groundwater elevation data, and collection of groundwater samples for the analysis of a subset of metals on a quarterly basis, for a period of three years. The results of the subsequent investigation identified that certain metals were present in the groundwater above the U.S. EPA's Safe Drinking Water Act's maximum contaminant level (MCL) established in 40 CFR §141.62, and concluded that the groundwater quality in the surrounding area may have been affected by the historical use of the CCR units.

Based on the groundwater sampling along with anticipated retirement of the plant combined with the CCR Rule requirements, BPW decided to close the CCR units through removal of CCR and decontamination of the CCR units, in accordance with 40 CFR §257.102; and initiate an assessment of corrective measures, in accordance with 40 CFR §257.96. Final closure of the CCR units is currently being completed in substantial conformance with 40 CFR §257.101 and 40 CFR §257.103, and the written closure plan prepared by NTH Consultants, Ltd., (NTH) dated October 17, 2016. BPW initiated removal of CCR material from the CCR units in June 2017. Two of the existing downgradient monitoring wells were removed during closure of the CCR units. Additionally, based on previous investigation findings, an upgradient monitoring well used during the 2011 study may not have been installed at a location that provided a true background determination for the area around JDY, and was also removed during closure of the CCR units.



## **4.0 ACTIONS COMPLETED**

### **4.1 Development of Sampling and Analysis Plan**

Consistent with the requirements of 40 CFR §257.93, a Groundwater Sampling and Analysis Plan (SAP) was developed in October 2017 to evaluate background and downgradient groundwater quality within the JDY plant property (Site), and confirm compliance with the groundwater monitoring and corrective action requirements.

As discussed previously, BPW conducted groundwater monitoring prior to the effective date of the CCR rules and elected to proceed with CCR removal and clean closure at the site. The SAP was developed to collect necessary information to confirm clean closure.

### **4.2 Update to Groundwater Monitoring System**

To comply with the requirements of 40 CFR §257.93, NTH designed an updated groundwater monitoring system that is representative of groundwater potentially affected by the CCR units. West Michigan Drilling installed three monitoring wells on November 27, 2017, with oversight by NTH Consultants, Ltd. (NTH) personnel, using a CME 550 ATV drill rig. The wells were installed using 4.25-inch hollow-stem augers to the following depths and corresponding elevations:

<b>Well</b>	<b>Depth (feet below ground surface)</b>	<b>Screen Tip Elevation (ft)</b>
MW-1	14	571.21
MW-2	13	569.54
MW-3	15	566.98

Split spoon samplers were used to collect and classify soil layers in the field based on visual observation as shown on the test boring logs provided in Appendix B. The wells were constructed of two-inch diameter polyvinyl chloride casings and well screens. The well screens were 5-feet long with 0.01-inch slot thickness.



All of the monitoring wells were finished with an above ground metal protective casing and concrete pad. Well construction details, including casing and screen material, diameter, length of well casing, length and position of slotted casing, thickness, position and composition of surface seal, sanitary seal, and sand pack, etc. is provided on the well installation logs, which are included in Appendix B. The logs also provide well survey information, including top of casing elevation, ground surface elevation, and well screen tip elevation.

A review of information regarding the hydrogeologic conditions of the site available at the time the SAP was developed, indicates that groundwater generally flows east-to-west across the site and discharges to the Macatawa River/Lake Macatawa. Based on this information, existing piezometer PZ-1 is located hydraulically upgradient of the former CCR bottom ash lagoons. PZ-1 was previously identified and sampled as monitoring well MW-7. Groundwater samples from this well represent background groundwater quality that has not been affected by the CCR units. Therefore, PZ-1 was redeveloped and used as an upgradient monitoring well. Figure 2 provides the location of the monitoring wells.

The downgradient monitoring wells labeled as MW-1, MW-2, and MW-3 on Figure 2, were installed at locations that represent the quality of groundwater passing the waste boundary of the former CCR units. Groundwater monitoring wells are screened at elevations between 567 and 576 ft in the upper portion of the unconfined uppermost water-bearing zone.

Based on data obtained from the monitoring wells during subsequent sampling events, hydrogeologic conditions will be re-evaluated to confirm groundwater flow direction and to ensure the effectiveness of the monitoring well system.

#### **4.3 Groundwater Sample Collection**

On January 10, 2018, representatives from NTH Consultants, Ltd. (NTH) collected the first of what will initially be quarterly groundwater samples collected for assessment monitoring from the groundwater monitoring system at the Site. The samples were submitted to the analytical laboratory for analysis of constituents listed in Appendix III and IV of 40 CFR §257.95.



Groundwater level data was collected from each monitoring well prior to sample collection. Upon arrival at the site, each monitoring well was opened, and allowed to equilibrate with ambient air pressures, prior to measuring the depths to water. Groundwater level measurements were taken to the nearest 0.01 foot from the entire monitoring well network prior to sampling. The wells were gauged on the same day to provide an interpretative groundwater flow map and to minimize temporal bias of measured groundwater elevation changes for the monitoring well network.

Depth to water was measured from established and surveyed top of casing reference points. Groundwater levels, well conditions, and pertinent observations were recorded on a groundwater-sampling log. Appendix C includes copies of the sampling logs. The water level data obtained has been used to develop a groundwater contour map (Groundwater Flow Map – Figure 3), which presents the site's groundwater flow direction.

Sampling personnel collected groundwater samples from the monitoring wells using low-flow (minimal drawdown) groundwater sampling procedures (US EPA, 1996, rev. 2010). Tubing connected to a peristaltic pump was installed to a depth representing the middle of the saturated screen interval. The polyethylene tubing discharge line from the peristaltic pump was connected to a flow-cell and multi-meter to collect water quality indicator parameters during well purging to determine water quality stabilization.

The pump was operated at a rates less than 0.25 gallons per minute to ensure low volatilization and low well disturbance. Water quality indicator parameters and depth to water were recorded at 3 to 5 minute intervals during the purging process and recorded on the groundwater sampling log. Purging and sampling proceeded at a low pumping rate such that the water column in the well was not lowered more than 0.3 feet (4 inches) below the initial static depth to water measurement. The wells were sampled when three consecutive water quality measurements for pH, temperature, and conductivity met stabilization criteria. We note that stabilization criteria could not be met for turbidity in any of the monitoring wells. Prior to the next sampling event these wells will be redeveloped, which may allow the turbidity measurements to stabilize during future sampling events. Likewise, piezometer PZ-1 could not be stabilized due to excessive drawdown; therefore, three well volumes were removed using the peristaltic pump, prior to sample collection.





Samples were collected immediately following stabilization of three of the four field parameters or at PZ-1, after three well volumes were removed. Groundwater samples were collected into laboratory provided sample containers required for the specified analyses. The groundwater samples were collected from the discharge tubing upstream of the water quality meter flow cell. Care was taken to allow for a non-turbulent filling of laboratory containers. Samples were not filtered in the field to provide a measure of total recoverable metals that will include both the dissolved and particulate fractions of metals in natural waters, consistent with 40 CFR §257.93 (h)(2)(i).

The samples were labelled, stored, and transported to the laboratory under proper chain-of-custody. Following collection, samples were immediately labelled, logged on the chain-of-custody, and placed in a cooler with ice prior to delivery to the laboratory with a signed Chain-of-Custody. The chain-of-custody provides documentation of actual sample storage and transport, and contains the dates and times of collection, laboratory receipt, and acknowledgment of analyses to be completed.

Quality assurance/quality control (QA/QC) samples were collected to ensure sample containers are free of analytes of interest, assess the variability of the sampling and laboratory methods, and monitor the effectiveness of decontamination protocols. One field duplicate, one matrix spike, one matrix spike duplicate, one field blank, and one equipment blank were collected for QA/QC purposes.

#### **4.4 Groundwater Sample Analysis and Data Evaluation**

Groundwater samples were submitted to ALS Environmental Laboratory, in Holland, Michigan, for the analyses specified in Appendix III and IV to Part 257. The laboratory results, corresponding analytical methods, and practical quantitation limits (PQL) for each constituent are provided in the analytical report included in Appendix C. In general, the laboratory PQLs (reporting limits) are consistent with the reporting limits stated in the March 2018 revised SAP. With the exception of thallium, the reporting limits are below the established MCLs. We note however, that, communication with the laboratory indicates that the concentrations reported for thallium in all the wells analyzed are below the method detection limit of 0.00016 mg/L, which is



substantially lower than the MCL of 0.002 mg/L. In the future, the laboratory will report thallium at a PQL that meets the MCL. We also note that, due to dilution for high concentrations of non-target analytes or an effervescent matrix, a few parameters in selected monitoring wells had elevated reporting limits, as shown on the laboratory analytical report included in Appendix C.

The results of the quarterly groundwater sampling events will be compared to applicable groundwater standards for determination of clean closure. The groundwater protection standards for each constituent in Appendix IV will be established in accordance with 40 CFR §257.95(h). For constituents for which MCLs have been established under 40 CFR §141.62 and 40 CFR §141.66, the groundwater protection standard will be the MCL for that constituent. Where MCLs have not been established for the Appendix III constituents, the groundwater protection standard will be the statistically developed background concentration for that constituent in accordance with 40 CFR §257.91, or as noted in the preamble to the rule “in excess of Agency-recommended limits or factors.” It should be noted that Michigan’s groundwater cleanup criteria developed according to Part 201 of Act 451 will be considered by BPW when evaluating potential “Agency-recommended limits or factors.” For those constituents where the statistically developed background level is higher than the MCL, the groundwater protection standard will be the statistically developed background concentration.

As discussed in the facility’s SAP and in accordance with 40 CFR §257.93, the data collected from the background monitoring well will be used to calculate background concentrations for each constituent. If appropriate and supported by the data distribution, fewer samples may be utilized for the statistically calculated background concentrations. Background concentrations for each constituent will be calculated using an appropriate statistical method for each background monitoring well, selected based on the distribution of the data in accordance with 40 CFR §257.93, once an appropriate number of data has been collected.

For the current sampling event, we completed a preliminary evaluation of the data by comparing the results to the current MCL, as summarized on Table 1. A review of the results indicate that, in general, most of the Appendix IV constituents are below the current MCL with the exception of arsenic, which was reported above the MCL of 0.01 mg/L in upgradient piezometer PZ-1 (0.045



mg/L), and in downgradient monitoring well MW-1 (0.023 mg/L). We note that groundwater in upgradient piezometer PZ-1, which represents background groundwater quality that has not been affected by CCR units, has higher concentration of arsenic than downgradient monitoring well MW-1; this indicates that background levels of arsenic are higher than the MCL. Note also, that for a few other constituents with no established MCLs, the concentrations in upgradient well PZ-1 are higher than the downgradient monitoring wells. As discussed previously, where background levels are higher than MCL, or for constituents without established MCLs, we will statistically develop groundwater protection standards in accordance with 40 CFR §257.91.

## **5.0 PROBLEMS ENCOUNTERED**

As discussed previously, piezometer PZ-1 was purged using a volumetric procedure (removal of three well volumes) due to excessive drawdown. Additionally, stabilization criteria for turbidity could not be achieved in any of the monitoring wells. No additional problems were encountered with the implementation of the groundwater-monitoring program at the facility.

## **6.0 ACTIONS TO RESOLVE THE PROBLEM**

Monitoring well PZ-1 will be redeveloped using the surge and purge method to remove excess suspended solids present in the well prior to the next sampling event. If redevelopment is not effective in allowing for the use of low-flow technique, sample collection will proceed when three of the four stabilization criteria are met, and/or volumetric procedures utilized.

## **7.0 KEY ACTIVITIES FOR THE UPCOMING YEAR**

During the initial assessment monitoring period, the facility will continue to collect quarterly groundwater samples from the existing groundwater monitoring well network. Consistent with the requirements of the SAP, samples will be collected in April, July, and October of 2018, and January of 2019. The results of these sampling events will be provided in the update to the annual groundwater report by January 31, 2019.



## **8.0 RECORDKEEPING, NOTIFICATION, AND POSTING TO THE INTERNET**


Consistent with the requirements of 40 CFR §257.105 (h), this groundwater monitoring and corrective action report, will be placed in the Site's operating record by January 31, 2018. In accordance with 40 CFR §257.106 (h), BPW will notify the State Director that this report has been developed, and that this information has been placed in the operating record and on the owner or operator's publicly accessible internet site, in accordance with 40 CFR §257.107 (h).

# APPENDIX

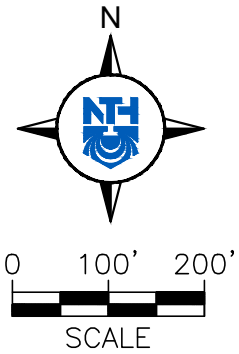


// FIGURES



<b>NTH PROJECT No.:</b> <b>62-160017</b> <b>DESIGNED BY:</b> <b>SLG</b> <b>DRAWN BY:</b> <b>SLG</b> <b>CHECKED BY:</b> <b>DRL</b>	<b>CAD FILE NAME:</b> <b>160017-JDY</b> <b>PLOT DATE:</b> <b>9/28/2016</b> <b>DRAWING SCALE:</b> <b>1" = 200'</b> <b>INCEPTION DATE:</b> <b>9/7/2016</b>	 <b>NTH Consultants, Ltd.</b> Infrastructure Engineering and Environmental Services	<p><b>SITE LOCATION PLAN</b></p> <p><b>JAMES DEYOUNG POWER PLANT</b>  <b>HOLLAND, MI</b></p>	<b>FIGURE:</b> <div>1</div>
--------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------	--------------------------------





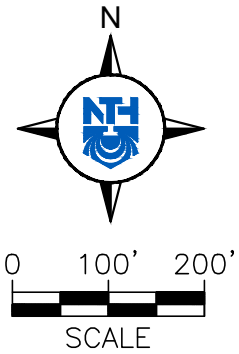
LEGEND

- MW-1 MONITORING WELL LOCATION
- PZ-1 EXISTING PIEZOMETER (UPGRADIENT MONITORING WELL)

NOTE: LOCATIONS AND DIMENSIONS ARE APPROXIMATE. NOT A LEGAL SURVEY.

MONITORING WELL LOCATION MAP	NTH Consultants, Ltd. Infrastructure Engineering and Environmental Services			
JAMES DEYOUNG POWER PLANT HOLLAND, MICHIGAN	NTH PROJECT No.:	73-160017	CAD FILE NAME:	160017-MWLM
	DESIGNED BY:	KWO	PLOT DATE:	1/23/2018
	DRAWN BY:	CRD	DRAWING SCALE:	1" = 200'
	CHECKED BY:	KWO	INCEPTION DATE:	10/13/2017
FIGURE:		2		





LEGEND

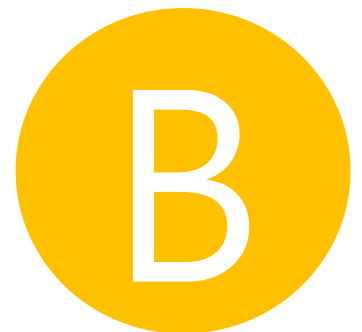
- MW-1 MONITORING WELL LOCATION
- PZ-1 EXISTING PIEZOMETER (UPGRADIENT MONITORING WELL)
- 582 — GROUNDWATER ELEVATION CONTOURS

NOTE: LOCATIONS AND DIMENSIONS ARE APPROXIMATE. NOT A LEGAL SURVEY.

GROUNDWATER FLOW MAP JANUARY 10, 2018		NTH PROJECT No.: 73-160017		CAD FILE NAME: 160017-GWFM	
JAMES DEYOUNG POWER PLANT HOLLAND, MICHIGAN		DESIGNED BY: KWO	PLOT DATE: 1/25/2018		DRAWING SCALE: 1" = 200'
		DRAWN BY: CRD	INCEPTION DATE: 10/13/2017		
		CHECKED BY: KWO			
FIGURE:		NTH Consultants, Ltd. Infrastructure Engineering and Environmental Services			
3					



# APPENDIX



// WELL BORING AND  
INSTALLATION LOGS



# NTH CONSULTANTS, LTD.

A NEYER, TISEO & HINDO COMPANY

41780 SIX MILE ROAD Φ NORTHVILLE, MI 48168

## LOG OF WELL INSTALLATION

PROJECT NAME: HOLLAND BPW

PROJECT No: 73-160017 DATE: 11/27/2017

WELL NUMBER: MW-1

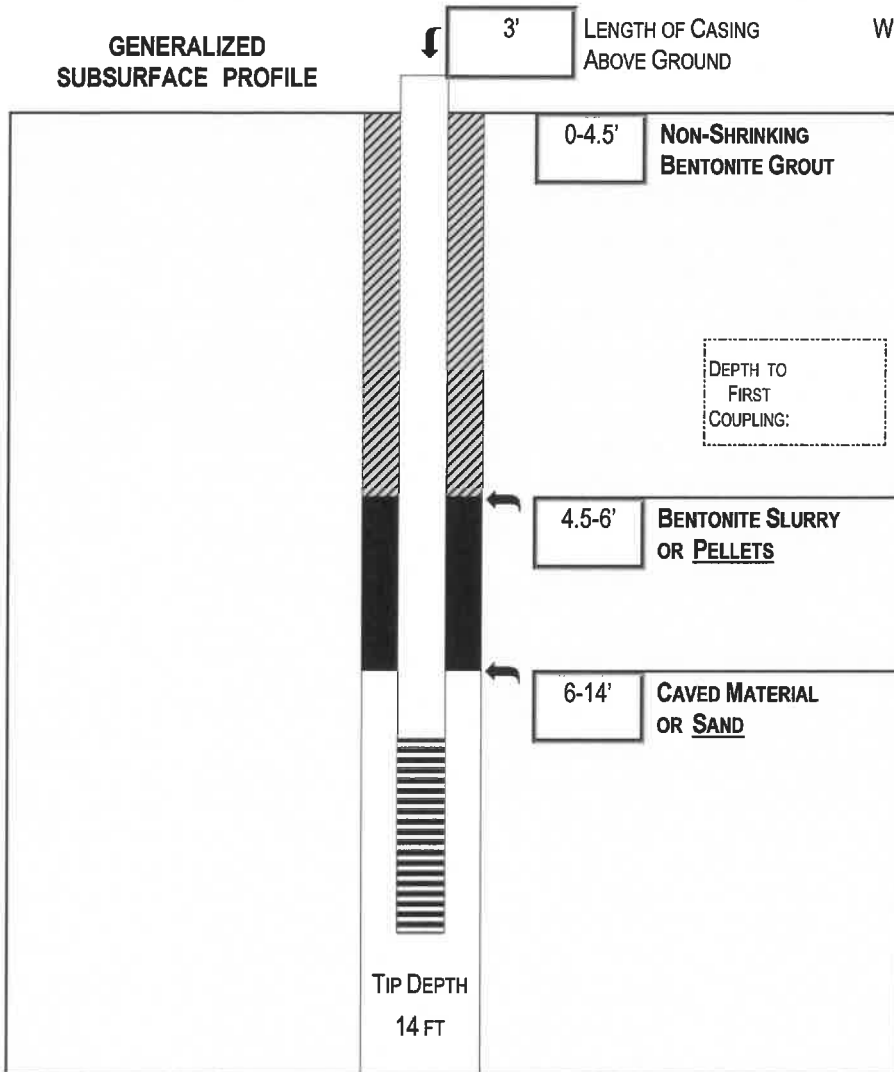
DATES OF INSTALLATION: 11/27/2017

TOP OF CASING ELEVATION: 588.53

GROUND SURFACE ELEVATION: 585.21

WELL SCREEN TIP ELEVATION: 571.21

### GENERALIZED SUBSURFACE PROFILE



### WELL CASING

DIAMETER: 2IN  
TOTAL LENGTH: 12'  
MATERIAL: SCH 40 PVC  
CAP? (Y/N): YES

### WELL SCREEN

DIAMETER: 2IN  
LENGTH: 5'  
MESH: 0.010'  
MATERIAL: SCH 40 PVC  
PLUG? (Y/N): YES

### PROTECTIVE CASING

MATERIAL: STEEL  
DIAMETER: 4IN SQUARE  
TOTAL LENGTH: 4.5'  
LENGTH ABOVE GROUND: 3'  
LOCK? (Y/N): YES

INSPECTOR: COURTNEY DANIOT & MIKE McNAMARA

CONTRACTOR: WEST MICHIGAN DRILLING

DRILLER: GARRICC STRAUCH

EQUIPMENT: CME 550 OFF ROAD

WELL TYPE: 2IN MONITORING

### FIELD NOTES

BAGS OF SAND: 2.5

BAGS OF CEMENT: N/A

LBS OF BENTONITE: PELLETS OR POWDER

OTHER WELL MATERIALS: \_\_\_\_\_

### WATER LEVEL INFORMATION

DATE	ELEVATION/COMMENT
11/28/17	6.18

### FINAL LOG NOTES

N: 476261.95 - E: 12654179.45

CHECKED BY: MRM

# LOG OF TEST BORING NO: MW-2

Project Name: Holland BPW  
Project Location: Holland, Michigan



NTH Consultants, Ltd.

NTH Proj. No.: 73-160017-04

Checked By: *ADD*

## SUBSURFACE PROFILE

## SOIL SAMPLE DATA

ELEV. (FT)	PRO-FILE	ELEV	GROUND SURFACE ELEVATION: 582.5	DEPTH	DEPTH (FT)	SAMPLE TYPE/NO.	BLOWS/ 6-INCHES	STD. PEN RESIST. (N)	REC (in)	FIELD TEST (ppm)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
580		579.5	SANDY TOPSOIL AND SAND	3.0		S-1	2 2 3	5	12				
			Wet SILTY SAND	5		S-2	3 2 2	4	8				
575						S-3	1 1 1	2	8				
		572.5	Wet SILTY SAND AND MARL with Trace Organics	10.0	10	S-4	— — 1	1	6				
570													
		567.5	END OF BORING AT 15.0 FEET.	15.0	15	S-5	1 3 3	6	18				
565													
560													
555													

**Total Depth:** 15 FT  
**Drilling Start Date:** 11/28/18  
**Drilling End Date:** 11/28/18  
**Inspector:** M. McNamara  
**Contractor:** West Michigan Drilling  
**Driller:**  
**Drilling Method:**  
CME-550X with 4 1/4" inside-diameter with hollow-stem augers to end of boring.

**Plugging Procedure:**  
Well Installation

**Water Level Observation:**  
Groundwater encountered at 3.99 ft bgs; borehole dry upon completion.

**Notes:**  
\* = pocket penetrometer value  
WOH = weight of hammer

**GPS Coordinates:**  
N: 476290.81 E: 12653897.91

Figure No.

LOG OF TEST BORING 73-160017.GPJ NTH CORPORATE.GDT 3/12/18

# NTH CONSULTANTS, LTD.

A NEYER, TISEO & HINDO COMPANY

41780 SIX MILE ROAD Φ NORTHVILLE, MI 48168

## LOG OF WELL INSTALLATION

PROJECT NAME: HOLLAND BPW

PROJECT No: 73-160017 DATE: 11/28/2017

WELL NUMBER: MW-2

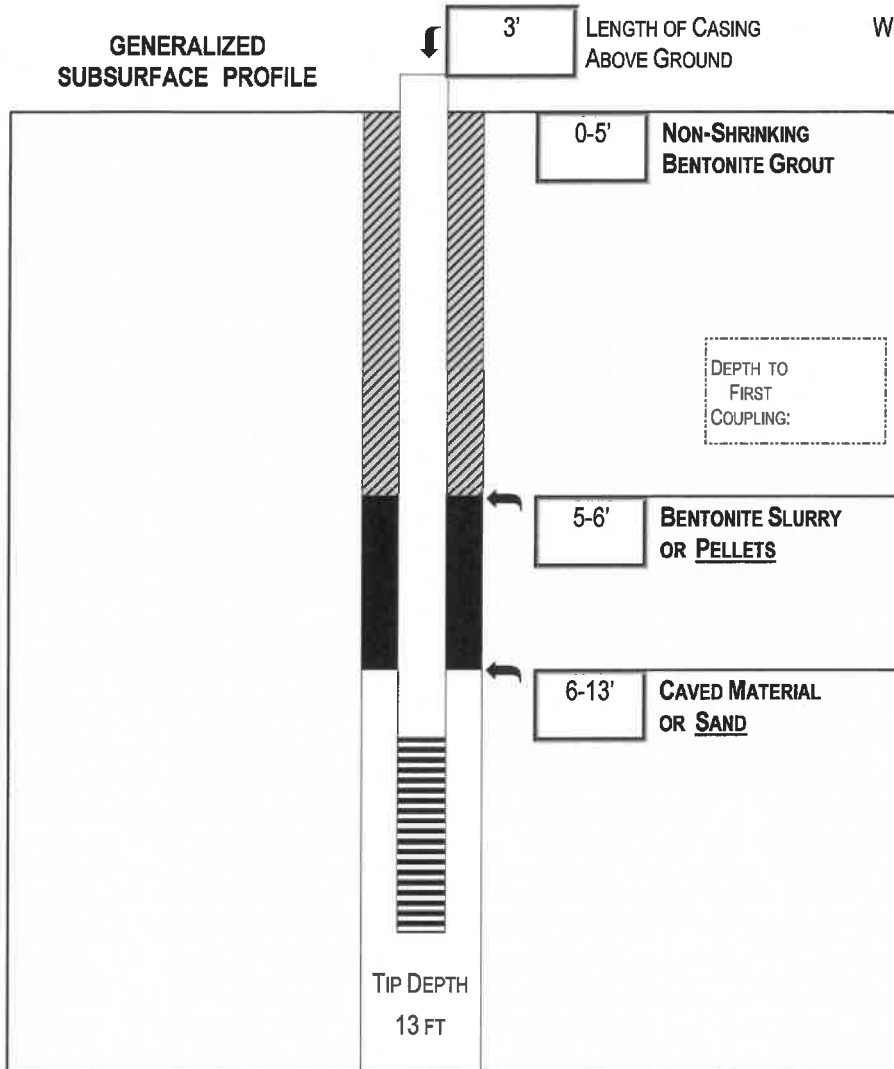
DATES OF INSTALLATION: 11/28/2017

TOP OF CASING ELEVATION: 585.49

GROUND SURFACE ELEVATION: 582.54

WELL SCREEN TIP ELEVATION: 569.54

### GENERALIZED SUBSURFACE PROFILE



### WELL CASING

DIAMETER: 2IN  
TOTAL LENGTH: 11'  
MATERIAL: SCH 40 PVC  
CAP? (Y/N): YES

### WELL SCREEN

DIAMETER: 2IN  
LENGTH: 5'  
MESH: 0.010'  
MATERIAL: SCH 40 PVC  
PLUG? (Y/N): YES

### PROTECTIVE CASING

MATERIAL: STEEL  
DIAMETER: 4IN SQUARE  
TOTAL LENGTH: 4.5'  
LENGTH ABOVE GROUND: 3'  
LOCK? (Y/N): YES

INSPECTOR: COURTNEY DANIOT & MIKE McNAMARA

CONTRACTOR: WEST MICHIGAN DRILLING

DRILLER: GARRICC STRAUCH

EQUIPMENT: CME 550 OFF ROAD

WELL TYPE: 2IN MONITORING

### FIELD NOTES

BAGS OF SAND: 2.5

BAGS OF CEMENT: N/A

LBS OF BENTONITE: PELLETS OR POWDER

OTHER WELL MATERIALS: \_\_\_\_\_

### WATER LEVEL INFORMATION

DATE	ELEVATION/COMMENT
11/28/17	3.99

### FINAL LOG NOTES

N: 476290.81 - E: 12653897.91

CHECKED BY: MRM

# LOG OF TEST BORING NO: MW-3

Project Name: Holland BPW  
Project Location: Holland, Michigan



NTH Consultants, Ltd.

NTH Proj. No.: 73-160017-04

Checked By: *[Signature]*

## SUBSURFACE PROFILE

## SOIL SAMPLE DATA

ELEV. (FT)	PRO-FILE	ELEV	GROUND SURFACE ELEVATION: 582.0	DEPTH	DEPTH (FT)	SAMPLE TYPE/NO.	BLOWS/ 6-INCHES	STD. PEN RESIST. (N)	REC (in)	FIELD TEST (ppm)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
580						S-1	2 2 2	4	15				
			FILL: Moist to Wet SAND AND SILT		5	S-2	2 1 1	2	8				
575						S-3	1 1 1	2	18				
		573.0		9.0	10	S-4	-- 1 --	1	6				
570			Wet, Very Loose FINE TO MEDIUM SAND										
		567.5		14.5	15	S-5	1 1 1	2	6				
		567.0	Black CLAYEY MARL	15.0									
			END OF BORING AT 15.0 FEET.										
565													
560													
555													

**Total Depth:** 15 FT  
**Drilling Start Date:** 11/27/18  
**Drilling End Date:** 11/27/18  
**Inspector:** M. McNamara  
**Contractor:** West Michigan Drilling  
**Driller:**  
**Drilling Method:**  
CME-550X with 4 1/4" inside-diameter with hollow-stem augers to end of boring.

**Plugging Procedure:**  
2" PVC Well Installation

**Water Level Observation:**  
Groundwater encountered at 5 ft bgs; at 4.55 ft bgs upon completion.

**Notes:**  
\* = pocket penetrometer value  
WOH = weight of hammer

**GPS Coordinates:**  
N: 476607.46 E: 12654048.16

Figure No.

LOG OF TEST BORING 73-160017.GPJ NTH CORPORATE.GDT 3/12/18

# NTH CONSULTANTS, LTD.

A NEYER, TISEO & HINDO COMPANY

41780 SIX MILE ROAD Φ NORTHVILLE, MI 48168

## LOG OF WELL INSTALLATION

PROJECT NAME: HOLLAND BPW

PROJECT No: 73-160017 DATE: 11/27/2017

WELL NUMBER: MW-3

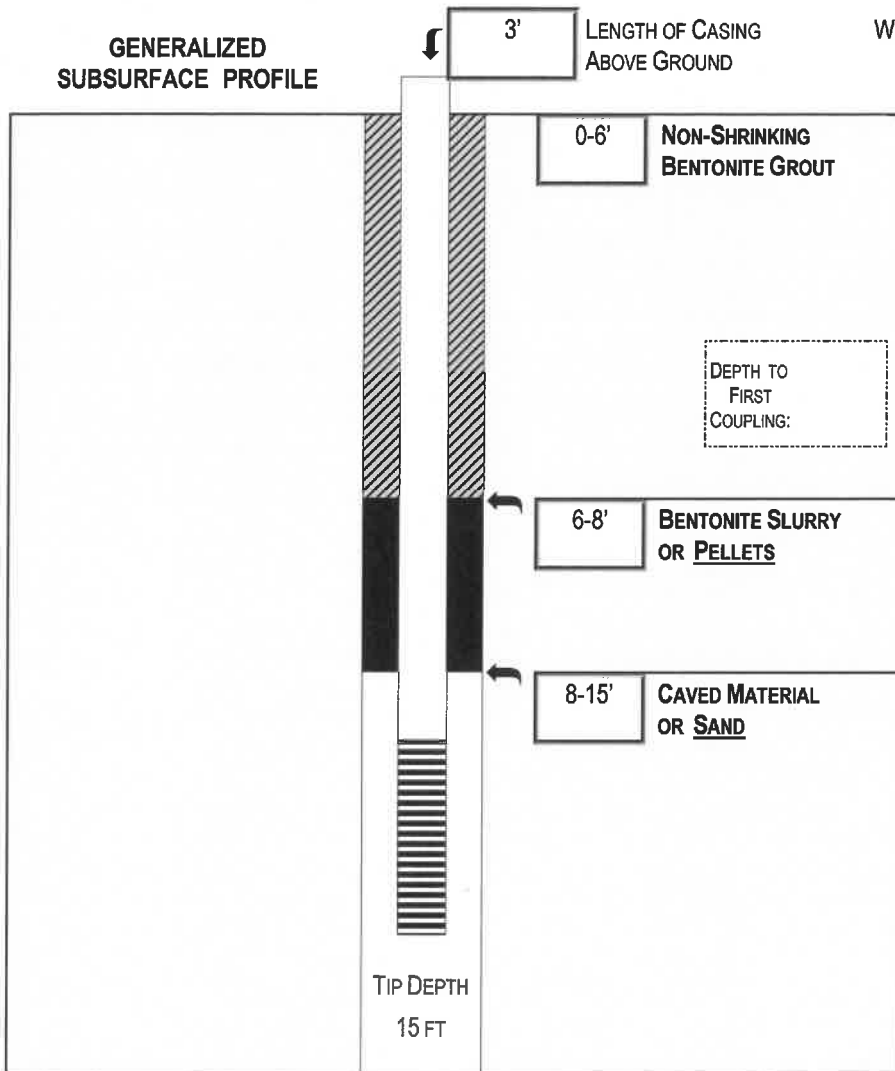
DATES OF INSTALLATION: 11/27/2017

TOP OF CASING ELEVATION: 585.30

GROUND SURFACE ELEVATION: 581.98

WELL SCREEN TIP ELEVATION: 566.98

### GENERALIZED SUBSURFACE PROFILE



### WELL CASING

DIAMETER: 2IN  
TOTAL LENGTH: 13'  
MATERIAL: SCH 40 PVC  
CAP? (Y/N): YES

### WELL SCREEN

DIAMETER: 2IN  
LENGTH: 5'  
MESH: 0.010'  
MATERIAL: SCH 40 PVC  
PLUG? (Y/N): YES

### PROTECTIVE CASING

MATERIAL: STEEL  
DIAMETER: 4IN SQUARE  
TOTAL LENGTH: 4.5'  
LENGTH ABOVE GROUND: 3'  
LOCK? (Y/N): YES

INSPECTOR: COURTNEY DANIOT & MIKE McNAMARA

CONTRACTOR: WEST MICHIGAN DRILLING

DRILLER: GARRICC STRAUCH

EQUIPMENT: CME 550 OFF ROAD

WELL TYPE: 2IN MONITORING

### FIELD NOTES

BAGS OF SAND: 3

BAGS OF CEMENT: N/A

LBS OF BENTONITE: PELLETS OR POWDER

OTHER WELL MATERIALS:

### WATER LEVEL INFORMATION

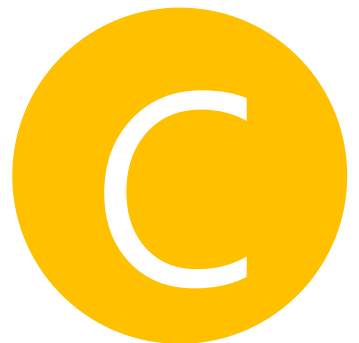
DATE	ELEVATION/COMMENT
11/28/17	4.55

### FINAL LOG NOTES

N: 476607.46 - E: 12654048.16

CHECKED BY: MRM

# APPENDIX



// SUMMARY TABLE OF  
ANALYTICAL RESULTS

// GROUNDWATER ANALYTICAL RESULTS

// GROUNDWATER SAMPLING COLLECTION LOGS



# HOLLAND BOARD OF PUBLIC WORKS - JAMES DeYOUNG POWER PLANT

TABLE 1

## SUMMARY OF LABORATORY ANALYTICAL RESULTS ANNUAL GROUNDWATER REPORT

PARAMETER		Units	Upgradient Well	Downgradient Wells				Groundwater Protection Standard
			PZ-1 <sup>+</sup>	MW-1	MW-1 <sup>(1)</sup>	MW-2	MW-3	Maximum Contaminant Level <sup>[2]</sup>
			1/10/18	1/10/18	1/10/18	1/10/18	1/10/18	
APPENDIX IV TO CFR PART 257	Antimony	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.006
	Arsenic	mg/L	0.045	0.023	0.022	<0.005	<0.005	0.01
	Barium	mg/L	0.045	0.34	0.33	0.2	0.034	2
	Beryllium	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	0.004
	Cadmium	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	0.005
	Chromium	mg/L	0.0067	<0.005	<0.005	<0.005	<0.005	0.1
	Cobalt	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	---
	Fluoride	mg/L	1.4	<1.0	<1.0	<5.0	<10	4
	Lead	mg/L	0.044	<0.005	<0.005	<0.005	<0.005	0.015
	Lithium	mg/L	<0.01	0.14	0.13	<0.10	<1.0	---
	Mercury	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.002
	Molybdenum	mg/L	0.12	<0.005	<0.005	<0.005	<0.005	---
	Selenium	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.05
	Thallium	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.002
	Radium 226/228 Combined <sup>[4]</sup>	pCi/L	0.63	<0.22/<0.96	<0.24/<1.01	<0.24/<0.91	1.19	5
APPENDIX III TO CFR PART 257	Boron	mg/L	0.23	1.1	1.1	0.69	0.79	---
	Calcium	mg/L	38	140	130	81	320	---
	Chloride	mg/L	<100	280	300	56	<1000	250 <sup>[3]</sup>
	Fluoride	mg/L	1.4	<1.0	<1.0	<5.0	<10	4
	pH	s.u.	8.35	6.84	6.89	7.08	6.4	6.5-8.5
	Sulfate	mg/L	18	<250	<250	<50	1200	250 <sup>[3]</sup>
	Total Dissolved Solids	mg/L	1200	1100	980	1300	2300	500 <sup>[3]</sup>

1) Duplicate Sample

2) Maximum Contaminant Level (MCL) promulgated by the USEPA pursuant to the provisions of Section 1412 of the Safe Drinking Water Act (40 CFR Part 141).

3) Secondary drinking water standards established for aesthetic purposes

4) Sum of values reported above the minimum detectable concentration (MDC) for radium 226 and radium 228.

5) <sup>+</sup> - PZ-1 was previously identified and sampled with the MW-7 identifier.

< = parameter not detected at or above laboratory report limit or, in the case of radium 226/228, above the MDC.



26-Feb-2018

Karen Okonta  
NTH Consultants, Ltd.  
41780 Six Mile Road  
Northville, MI 48168

Re: **Holland Board of Public Works (73-160017-04)**

Work Order: **1801438**

Dear Karen,

ALS Environmental received 7 samples on 10-Jan-2018 05:21 PM for the analyses presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental and for only the analyses requested.

Sample results are compliant with industry accepted practices and Quality Control results achieved laboratory specifications. Any exceptions are noted in the Case Narrative, or noted with qualifiers in the report or QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained from ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

The total number of pages in this report is 21.

If you have any questions regarding this report, please feel free to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read "Chad Whelton".

Electronically approved by: Chad Whelton

Chad Whelton  
Project Manager

Certificate No: MI: 0022

### Report of Laboratory Analysis

ADDRESS 3352 128th Ave Holland, Michigan 49424 | PHONE (616) 399-6070 | FAX (616) 399-6185

ALS GROUP USA, CORP Part of the ALS Laboratory Group A Campbell Brothers Limited Company

Environmental 

[www.alsglobal.com](http://www.alsglobal.com)

RIGHT SOLUTIONS RIGHT PARTNER

**Client:** NTH Consultants, Ltd.  
**Project:** Holland Board of Public Works (73-160017-04)  
**Work Order:** 1801438

**Work Order Sample Summary**

<u>Lab Samp ID</u>	<u>Client Sample ID</u>	<u>Matrix</u>	<u>Tag Number</u>	<u>Collection Date</u>	<u>Date Received</u>	<u>Hold</u>
1801438-01	MW-3	Groundwater		1/10/2018 13:50	1/10/2018 17:21	<input type="checkbox"/>
1801438-01	MW-3	Groundwater		1/10/2018 13:50	1/10/2018 17:21	<input type="checkbox"/>
1801438-02	MW-2	Groundwater		1/10/2018 15:20	1/10/2018 17:21	<input type="checkbox"/>
1801438-02	MW-2	Groundwater		1/10/2018 15:20	1/10/2018 17:21	<input type="checkbox"/>
1801438-03	Equipment Blank	Water		1/10/2018 15:30	1/10/2018 17:21	<input type="checkbox"/>
1801438-03	Equipment Blank	Water		1/10/2018 15:30	1/10/2018 17:21	<input type="checkbox"/>
1801438-04	Field Blank	Water		1/10/2018 15:40	1/10/2018 17:21	<input type="checkbox"/>
1801438-04	Field Blank	Water		1/10/2018 15:40	1/10/2018 17:21	<input type="checkbox"/>
1801438-05	MW-1	Groundwater		1/10/2018 16:25	1/10/2018 17:21	<input type="checkbox"/>
1801438-05	MW-1	Groundwater		1/10/2018 16:25	1/10/2018 17:21	<input type="checkbox"/>
1801438-06	PZ-1	Groundwater		1/10/2018 16:50	1/10/2018 17:21	<input type="checkbox"/>
1801438-06	PZ-1	Groundwater		1/10/2018 16:50	1/10/2018 17:21	<input type="checkbox"/>
1801438-07	Field Duplicate	Groundwater		1/10/2018	1/10/2018 17:21	<input type="checkbox"/>
1801438-07	Field Duplicate	Groundwater		1/10/2018	1/10/2018 17:21	<input type="checkbox"/>

---

**Client:** NTH Consultants, Ltd.  
**Project:** Holland Board of Public Works (73-160017-04)  
**Work Order:** 1801438

---

**Case Narrative**

Radium-226/228 analysis performed by ALS Fort Collins laboratory.

Batch 112942, Method ICP\_6020\_W, Sample 1801438-01A MS/MSD: The MS/MSD recovery was outside of the control limit for Calcium; however, the result in the parent sample is greater than 4x the spike amount. No qualification is required.

Batch R228140, Method IC\_300.0\_WW, Sample 1801438-01B: The reporting limit for Fluoride is elevated due to dilution for high concentrations of non-target analytes or an effervescent matrix.

Batch R228140, Method IC\_300.0\_WW, Sample 1801438-01B: The reporting limits for Fluoride and Sulfate are elevated due to dilution for high concentrations of non-target analytes or an effervescent matrix.

**Client:** NTH Consultants, Ltd.  
**Project:** Holland Board of Public Works (73-160017-04)  
**WorkOrder:** 1801438

## **QUALIFIERS, ACRONYMS, UNITS**

<b><u>Qualifier</u></b>	<b><u>Description</u></b>
*	Value exceeds Regulatory Limit
**	Estimated Value
a	Analyte is non-accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
J	Analyte is present at an estimated concentration between the MDL and Report Limit
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL
X	Analyte was detected in the Method Blank between the MDL and Reporting Limit, sample results may exhibit background or reagent contamination at the observed level.

<b><u>Acronym</u></b>	<b><u>Description</u></b>
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection (see MDL)
LOQ	Limit of Quantitation (see PQL)
MBLK	Method Blank
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PQL	Practical Quantitation Limit
RPD	Relative Percent Difference
TDL	Target Detection Limit
TNTC	Too Numerous To Count
A	APHA Standard Methods
D	ASTM
E	EPA
SW	SW-846 Update III

<b><u>Units Reported</u></b>	<b><u>Description</u></b>
mg/L	Milligrams per Liter
s.u.	Standard Units

# ALS Group, USA

Date: 26-Feb-18

Client: NTH Consultants, Ltd.

Project: Holland Board of Public Works (73-160017-04)

Sample ID: MW-3

Collection Date: 1/10/2018 01:50 PM

Work Order: 1801438

Lab ID: 1801438-01

Matrix: GROUNDWATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>MERCURY BY CVAA</b>						
			<b>SW7470A</b>		Prep: SW7470 1/24/18 14:41	Analyst: <b>RSH</b>
Mercury	ND		0.00020	mg/L	1	1/24/2018 03:45 PM
<b>METALS BY ICP-MS</b>						
			<b>SW6020A</b>		Prep: SW3005A 1/16/18 12:53	Analyst: <b>JF</b>
Antimony	ND		0.0050	mg/L	1	1/18/2018 08:31 PM
Arsenic	ND		0.0050	mg/L	1	1/18/2018 08:31 PM
<b>Barium</b>	<b>0.034</b>		<b>0.0050</b>	<b>mg/L</b>	1	1/19/2018 02:14 PM
Beryllium	ND		0.0020	mg/L	1	1/18/2018 08:31 PM
<b>Boron</b>	<b>0.79</b>		<b>0.020</b>	<b>mg/L</b>	1	1/18/2018 08:31 PM
Cadmium	ND		0.0020	mg/L	1	1/18/2018 08:31 PM
<b>Calcium</b>	<b>320</b>		<b>5.0</b>	<b>mg/L</b>	10	1/19/2018 02:19 PM
Chromium	ND		0.0050	mg/L	1	1/18/2018 08:31 PM
Cobalt	ND		0.0050	mg/L	1	1/18/2018 08:31 PM
Lead	ND		0.0050	mg/L	1	1/18/2018 08:31 PM
Lithium	ND		1.0	mg/L	100	1/22/2018 01:11 PM
Molybdenum	ND		0.0050	mg/L	1	1/18/2018 08:31 PM
Selenium	ND		0.0050	mg/L	1	1/18/2018 08:31 PM
Thallium	ND		0.0050	mg/L	1	1/18/2018 08:31 PM
<b>ANIONS BY ION CHROMATOGRAPHY</b>						
			<b>E300.0</b>			Analyst: <b>EE</b>
Chloride	ND		1,000	mg/L	100	1/12/2018 01:39 PM
Fluoride	ND		10	mg/L	10	1/12/2018 01:20 PM
<b>Sulfate</b>	<b>1,200</b>		<b>1,000</b>	<b>mg/L</b>	100	1/12/2018 01:39 PM
<b>PH (LABORATORY)</b>						
			<b>A4500-H B-11</b>			Analyst: <b>ED</b>
pH (laboratory)	<b>6.40</b>		<b>0.100</b>	<b>s.u.</b>	1	1/12/2018 02:20 PM
<b>TOTAL DISSOLVED SOLIDS</b>						
			<b>A2540 C-11</b>		Prep: FILTER 1/17/18 08:00	Analyst: <b>MT</b>
Total Dissolved Solids	<b>2,300</b>		<b>20</b>	<b>mg/L</b>	1	1/17/2018 01:13 PM

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

# ALS Group, USA

Date: 26-Feb-18

Client: NTH Consultants, Ltd.

Project: Holland Board of Public Works (73-160017-04)

Sample ID: MW-2

Collection Date: 1/10/2018 03:20 PM

Work Order: 1801438

Lab ID: 1801438-02

Matrix: GROUNDWATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>MERCURY BY CVAA</b>						
			<b>SW7470A</b>		Prep: SW7470 1/24/18 14:41	Analyst: <b>RSH</b>
Mercury	ND		0.00020	mg/L	1	1/24/2018 03:53 PM
<b>METALS BY ICP-MS</b>						
			<b>SW6020A</b>		Prep: SW3005A 1/16/18 12:53	Analyst: <b>JF</b>
Antimony	ND		0.0050	mg/L	1	1/18/2018 08:36 PM
Arsenic	ND		0.0050	mg/L	1	1/18/2018 08:36 PM
<b>Barium</b>	<b>0.20</b>		<b>0.0050</b>	<b>mg/L</b>	1	1/18/2018 08:36 PM
Beryllium	ND		0.0020	mg/L	1	1/18/2018 08:36 PM
<b>Boron</b>	<b>0.69</b>		<b>0.020</b>	<b>mg/L</b>	1	1/18/2018 08:36 PM
Cadmium	ND		0.0020	mg/L	1	1/18/2018 08:36 PM
<b>Calcium</b>	<b>81</b>		<b>0.50</b>	<b>mg/L</b>	1	1/18/2018 08:36 PM
Chromium	ND		0.0050	mg/L	1	1/18/2018 08:36 PM
Cobalt	ND		0.0050	mg/L	1	1/18/2018 08:36 PM
Lead	ND		0.0050	mg/L	1	1/18/2018 08:36 PM
Lithium	ND		0.10	mg/L	10	1/22/2018 01:16 PM
Molybdenum	ND		0.0050	mg/L	1	1/18/2018 08:36 PM
Selenium	ND		0.0050	mg/L	1	1/18/2018 08:36 PM
Thallium	ND		0.0050	mg/L	1	1/18/2018 08:36 PM
<b>ANIONS BY ION CHROMATOGRAPHY</b>						
			<b>E300.0</b>			Analyst: <b>EE</b>
<b>Chloride</b>	<b>56</b>		<b>50</b>	<b>mg/L</b>	5	1/12/2018 02:56 PM
Fluoride	ND		5.0	mg/L	5	1/12/2018 01:58 PM
Sulfate	ND		50	mg/L	5	1/12/2018 01:58 PM
<b>PH (LABORATORY)</b>						
			<b>A4500-H B-11</b>			Analyst: <b>ED</b>
pH (laboratory)	7.08		0.100	s.u.	1	1/12/2018 02:20 PM
<b>TOTAL DISSOLVED SOLIDS</b>						
			<b>A2540 C-11</b>		Prep: FILTER 1/17/18 08:00	Analyst: <b>MT</b>
Total Dissolved Solids	1,300		20	mg/L	1	1/17/2018 01:13 PM

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

# ALS Group, USA

Date: 26-Feb-18

Client: NTH Consultants, Ltd.

Project: Holland Board of Public Works (73-160017-04)

Work Order: 1801438

Sample ID: Equipment Blank

Lab ID: 1801438-03

Collection Date: 1/10/2018 03:30 PM

Matrix: WATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>MERCURY BY CVAA</b>						
			<b>SW7470A</b>		Prep: SW7470 1/24/18 14:41	Analyst: <b>RSH</b>
Mercury	ND		0.00020	mg/L	1	1/24/2018 03:56 PM
<b>METALS BY ICP-MS</b>						
			<b>SW6020A</b>		Prep: SW3005A 1/16/18 12:53	Analyst: <b>JF</b>
Antimony	ND		0.0050	mg/L	1	1/18/2018 08:38 PM
Arsenic	ND		0.0050	mg/L	1	1/18/2018 08:38 PM
Barium	ND		0.0050	mg/L	1	1/19/2018 02:26 PM
Beryllium	ND		0.0020	mg/L	1	1/18/2018 08:38 PM
Boron	ND		0.020	mg/L	1	1/18/2018 08:38 PM
Cadmium	ND		0.0020	mg/L	1	1/18/2018 08:38 PM
Calcium	ND		0.50	mg/L	1	1/18/2018 08:38 PM
Chromium	ND		0.0050	mg/L	1	1/18/2018 08:38 PM
Cobalt	ND		0.0050	mg/L	1	1/18/2018 08:38 PM
Lead	ND		0.0050	mg/L	1	1/18/2018 08:38 PM
Lithium	ND		0.010	mg/L	1	1/19/2018 02:26 PM
Molybdenum	ND		0.0050	mg/L	1	1/18/2018 08:38 PM
Selenium	ND		0.0050	mg/L	1	1/18/2018 08:38 PM
Thallium	ND		0.0050	mg/L	1	1/18/2018 08:38 PM
<b>ANIONS BY ION CHROMATOGRAPHY</b>						
			<b>E300.0</b>			Analyst: <b>EE</b>
Chloride	ND		10	mg/L	1	1/12/2018 03:15 PM
Fluoride	ND		1.0	mg/L	1	1/12/2018 03:15 PM
Sulfate	ND		10	mg/L	1	1/12/2018 03:15 PM
<b>PH (LABORATORY)</b>						
			<b>A4500-H B-11</b>			Analyst: <b>ED</b>
pH (laboratory)	7.29		0.100	s.u.	1	1/12/2018 02:20 PM
<b>TOTAL DISSOLVED SOLIDS</b>						
			<b>A2540 C-11</b>		Prep: FILTER 1/17/18 08:00	Analyst: <b>MT</b>
Total Dissolved Solids	ND		10	mg/L	1	1/17/2018 01:13 PM

**Note:** See Qualifiers page for a list of qualifiers and their definitions.



# ALS Group, USA

Date: 26-Feb-18

Client: NTH Consultants, Ltd.

Project: Holland Board of Public Works (73-160017-04)

Work Order: 1801438

Sample ID: Field Blank

Lab ID: 1801438-04

Collection Date: 1/10/2018 03:40 PM

Matrix: WATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>MERCURY BY CVAA</b>						
			<b>SW7470A</b>		Prep: SW7470 1/24/18 14:41	Analyst: <b>RSH</b>
Mercury	ND		0.00020	mg/L	1	1/24/2018 03:58 PM
<b>METALS BY ICP-MS</b>						
			<b>SW6020A</b>		Prep: SW3005A 1/16/18 12:53	Analyst: <b>JF</b>
Antimony	ND		0.0050	mg/L	1	1/18/2018 08:39 PM
Arsenic	ND		0.0050	mg/L	1	1/18/2018 08:39 PM
Barium	ND		0.0050	mg/L	1	1/19/2018 02:27 PM
Beryllium	ND		0.0020	mg/L	1	1/18/2018 08:39 PM
Boron	ND		0.020	mg/L	1	1/18/2018 08:39 PM
Cadmium	ND		0.0020	mg/L	1	1/18/2018 08:39 PM
Calcium	ND		0.50	mg/L	1	1/18/2018 08:39 PM
Chromium	ND		0.0050	mg/L	1	1/18/2018 08:39 PM
Cobalt	ND		0.0050	mg/L	1	1/18/2018 08:39 PM
Lead	ND		0.0050	mg/L	1	1/18/2018 08:39 PM
Lithium	ND		0.010	mg/L	1	1/19/2018 02:27 PM
Molybdenum	ND		0.0050	mg/L	1	1/18/2018 08:39 PM
Selenium	ND		0.0050	mg/L	1	1/18/2018 08:39 PM
Thallium	ND		0.0050	mg/L	1	1/18/2018 08:39 PM
<b>ANIONS BY ION CHROMATOGRAPHY</b>						
			<b>E300.0</b>			Analyst: <b>EE</b>
Chloride	ND		10	mg/L	1	1/12/2018 03:34 PM
Fluoride	ND		1.0	mg/L	1	1/12/2018 03:34 PM
Sulfate	ND		10	mg/L	1	1/12/2018 03:34 PM
<b>PH (LABORATORY)</b>						
pH (laboratory)	6.84		<b>A4500-H B-11</b>			Analyst: <b>ED</b>
			0.100	s.u.	1	1/12/2018 02:20 PM
<b>TOTAL DISSOLVED SOLIDS</b>						
			<b>A2540 C-11</b>		Prep: FILTER 1/17/18 08:00	Analyst: <b>MT</b>
Total Dissolved Solids	ND		10	mg/L	1	1/17/2018 01:13 PM

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

# ALS Group, USA

Date: 26-Feb-18

Client: NTH Consultants, Ltd.

Project: Holland Board of Public Works (73-160017-04)

Sample ID: MW-1

Collection Date: 1/10/2018 04:25 PM

Work Order: 1801438

Lab ID: 1801438-05

Matrix: GROUNDWATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>MERCURY BY CVAA</b>						
			<b>SW7470A</b>		Prep: SW7470 1/24/18 14:41	Analyst: <b>RSH</b>
Mercury	ND		0.00020	mg/L	1	1/24/2018 04:01 PM
<b>METALS BY ICP-MS</b>						
			<b>SW6020A</b>		Prep: SW3005A 1/16/18 12:53	Analyst: <b>JF</b>
Antimony	ND		0.0050	mg/L	1	1/18/2018 08:45 PM
<b>Arsenic</b>	<b>0.023</b>		<b>0.0050</b>	<b>mg/L</b>	1	1/18/2018 08:45 PM
<b>Barium</b>	<b>0.34</b>		<b>0.0050</b>	<b>mg/L</b>	1	1/18/2018 08:45 PM
Beryllium	ND		0.0020	mg/L	1	1/18/2018 08:45 PM
<b>Boron</b>	<b>1.1</b>		<b>0.20</b>	<b>mg/L</b>	10	1/22/2018 01:17 PM
Cadmium	ND		0.0020	mg/L	1	1/18/2018 08:45 PM
<b>Calcium</b>	<b>140</b>		<b>0.50</b>	<b>mg/L</b>	1	1/18/2018 08:45 PM
Chromium	ND		0.0050	mg/L	1	1/18/2018 08:45 PM
Cobalt	ND		0.0050	mg/L	1	1/18/2018 08:45 PM
Lead	ND		0.0050	mg/L	1	1/18/2018 08:45 PM
<b>Lithium</b>	<b>0.14</b>		<b>0.10</b>	<b>mg/L</b>	10	1/22/2018 01:17 PM
Molybdenum	ND		0.0050	mg/L	1	1/18/2018 08:45 PM
Selenium	ND		0.0050	mg/L	1	1/18/2018 08:45 PM
Thallium	ND		0.0050	mg/L	1	1/18/2018 08:45 PM
<b>ANIONS BY ION CHROMATOGRAPHY</b>						
			<b>E300.0</b>			Analyst: <b>EE</b>
<b>Chloride</b>	<b>280</b>		<b>250</b>	<b>mg/L</b>	25	1/15/2018 12:26 PM
Fluoride	ND		1.0	mg/L	1	1/15/2018 12:07 PM
Sulfate	ND		250	mg/L	25	1/15/2018 12:26 PM
<b>PH (LABORATORY)</b>						
			<b>A4500-H B-11</b>			Analyst: <b>ED</b>
<b>pH (laboratory)</b>	<b>6.84</b>		<b>0.100</b>	<b>s.u.</b>	1	1/12/2018 02:20 PM
<b>TOTAL DISSOLVED SOLIDS</b>						
			<b>A2540 C-11</b>		Prep: FILTER 1/17/18 08:00	Analyst: <b>MT</b>
<b>Total Dissolved Solids</b>	<b>1,100</b>		<b>20</b>	<b>mg/L</b>	1	1/17/2018 01:13 PM

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

# ALS Group, USA

Date: 26-Feb-18

Client: NTH Consultants, Ltd.

Project: Holland Board of Public Works (73-160017-04)

Sample ID: PZ-1

Collection Date: 1/10/2018 04:50 PM

Work Order: 1801438

Lab ID: 1801438-06

Matrix: GROUNDWATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>MERCURY BY CVAA</b>						
			<b>SW7470A</b>		Prep: SW7470 1/24/18 14:41	Analyst: <b>RSH</b>
Mercury	ND		0.00020	mg/L	1	1/24/2018 04:03 PM
<b>METALS BY ICP-MS</b>						
			<b>SW6020A</b>		Prep: SW3005A 1/16/18 12:53	Analyst: <b>JF</b>
Antimony	ND		0.0050	mg/L	1	1/18/2018 08:47 PM
Arsenic	0.045		0.0050	mg/L	1	1/18/2018 08:47 PM
Barium	0.045		0.0050	mg/L	1	1/19/2018 03:20 PM
Beryllium	ND		0.0020	mg/L	1	1/18/2018 08:47 PM
Boron	0.23		0.020	mg/L	1	1/19/2018 03:20 PM
Cadmium	ND		0.0020	mg/L	1	1/18/2018 08:47 PM
Calcium	38		0.50	mg/L	1	1/18/2018 08:47 PM
Chromium	0.0067		0.0050	mg/L	1	1/18/2018 08:47 PM
Cobalt	ND		0.0050	mg/L	1	1/18/2018 08:47 PM
Lead	0.044		0.0050	mg/L	1	1/18/2018 08:47 PM
Lithium	ND		0.010	mg/L	1	1/19/2018 03:20 PM
Molybdenum	0.12		0.0050	mg/L	1	1/18/2018 08:47 PM
Selenium	ND		0.0050	mg/L	1	1/18/2018 08:47 PM
Thallium	ND		0.0050	mg/L	1	1/18/2018 08:47 PM
<b>ANIONS BY ION CHROMATOGRAPHY</b>						
			<b>E300.0</b>			Analyst: <b>EE</b>
Chloride	ND		100	mg/L	10	1/15/2018 01:04 PM
Fluoride	1.4		1.0	mg/L	1	1/15/2018 12:45 PM
Sulfate	18		10	mg/L	1	1/15/2018 12:45 PM
<b>PH (LABORATORY)</b>						
			<b>A4500-H B-11</b>			Analyst: <b>ED</b>
pH (laboratory)	8.35		0.100	s.u.	1	1/12/2018 02:20 PM
<b>TOTAL DISSOLVED SOLIDS</b>						
			<b>A2540 C-11</b>		Prep: FILTER 1/17/18 08:00	Analyst: <b>MT</b>
Total Dissolved Solids	1,200		20	mg/L	1	1/17/2018 01:13 PM

Note: See Qualifiers page for a list of qualifiers and their definitions.

# ALS Group, USA

Date: 26-Feb-18

Client: NTH Consultants, Ltd.

Project: Holland Board of Public Works (73-160017-04)

Sample ID: Field Duplicate

Collection Date: 1/10/2018

Work Order: 1801438

Lab ID: 1801438-07

Matrix: GROUNDWATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>MERCURY BY CVAA</b>						
			<b>SW7470A</b>		Prep: SW7470 1/24/18 14:41	Analyst: <b>RSH</b>
Mercury	ND		0.00020	mg/L	1	1/24/2018 04:14 PM
<b>METALS BY ICP-MS</b>						
			<b>SW6020A</b>		Prep: SW3005A 1/16/18 12:53	Analyst: <b>JF</b>
Antimony	ND		0.0050	mg/L	1	1/18/2018 08:49 PM
Arsenic	0.022		0.0050	mg/L	1	1/18/2018 08:49 PM
Barium	0.33		0.0050	mg/L	1	1/18/2018 08:49 PM
Beryllium	ND		0.0020	mg/L	1	1/18/2018 08:49 PM
Boron	1.1		0.020	mg/L	1	1/19/2018 03:21 PM
Cadmium	ND		0.0020	mg/L	1	1/18/2018 08:49 PM
Calcium	130		0.50	mg/L	1	1/18/2018 08:49 PM
Chromium	ND		0.0050	mg/L	1	1/18/2018 08:49 PM
Cobalt	ND		0.0050	mg/L	1	1/18/2018 08:49 PM
Lead	ND		0.0050	mg/L	1	1/18/2018 08:49 PM
Lithium	0.13		0.010	mg/L	1	1/19/2018 03:21 PM
Molybdenum	ND		0.0050	mg/L	1	1/18/2018 08:49 PM
Selenium	ND		0.0050	mg/L	1	1/18/2018 08:49 PM
Thallium	ND		0.0050	mg/L	1	1/18/2018 08:49 PM
<b>ANIONS BY ION CHROMATOGRAPHY</b>						
			<b>E300.0</b>			Analyst: <b>EE</b>
Chloride	300		250	mg/L	25	1/15/2018 01:43 PM
Fluoride	ND		1.0	mg/L	1	1/15/2018 01:23 PM
Sulfate	ND		250	mg/L	25	1/15/2018 01:43 PM
<b>PH (LABORATORY)</b>						
			<b>A4500-H B-11</b>			Analyst: <b>ED</b>
pH (laboratory)	6.89		0.100	s.u.	1	1/12/2018 02:20 PM
<b>TOTAL DISSOLVED SOLIDS</b>						
			<b>A2540 C-11</b>		Prep: FILTER 1/17/18 08:00	Analyst: <b>MT</b>
Total Dissolved Solids	980		20	mg/L	1	1/17/2018 01:13 PM

Note: See Qualifiers page for a list of qualifiers and their definitions.

**Client:** NTH Consultants, Ltd.

**Work Order:** 1801438

**Project:** Holland Board of Public Works (73-160017-04)

## QC BATCH REPORT

Batch ID: **113318**

Instrument ID **HG1**

Method: **SW7470A**

<b>MBLK</b>		Sample ID: <b>MBLK-113318-113318</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/24/2018 03:40 PM</b>		
Client ID:		Run ID: <b>HG1_180124A</b>				SeqNo: <b>4862358</b>		Prep Date: <b>1/24/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Mercury ND 0.00020

<b>LCS</b>		Sample ID: <b>LCS-113318-113318</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/24/2018 03:43 PM</b>		
Client ID:		Run ID: <b>HG1_180124A</b>				SeqNo: <b>4862359</b>		Prep Date: <b>1/24/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Mercury 0.0016 0.00020 0.002 0 80 80-120 0

<b>MS</b>		Sample ID: <b>1801438-01AMS</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/24/2018 03:48 PM</b>		
Client ID: <b>MW-3</b>		Run ID: <b>HG1_180124A</b>				SeqNo: <b>4862361</b>		Prep Date: <b>1/24/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Mercury 0.00162 0.00020 0.002 0.000027 79.6 75-125 0

<b>MSD</b>		Sample ID: <b>1801438-01AMSD</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/24/2018 03:51 PM</b>		
Client ID: <b>MW-3</b>		Run ID: <b>HG1_180124A</b>				SeqNo: <b>4862362</b>		Prep Date: <b>1/24/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Mercury 0.00174 0.00020 0.002 0.000027 85.6 75-125 0.00162 7.14 20

The following samples were analyzed in this batch:

1801438-01A	1801438-02A	1801438-03A
1801438-04A	1801438-05A	1801438-06A
1801438-07A		

**Client:** NTH Consultants, Ltd.  
**Work Order:** 1801438  
**Project:** Holland Board of Public Works (73-160017-04)

## QC BATCH REPORT

Batch ID: **112942** Instrument ID **ICPMS3** Method: **SW6020A**

<b>MBLK</b>		Sample ID: <b>MBLK-112942-112942</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/18/2018 08:28 PM</b>		
Client ID:		Run ID: <b>ICPMS3_180118A</b>				SeqNo: <b>4854229</b>		Prep Date: <b>1/16/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Antimony	ND	0.0050								
Arsenic	ND	0.0050								
Beryllium	ND	0.0020								
Boron	ND	0.020								
Cadmium	ND	0.0020								
Calcium	ND	0.50								
Chromium	ND	0.0050								
Cobalt	ND	0.0050								
Lead	ND	0.0050								
Molybdenum	ND	0.0050								
Selenium	ND	0.0050								
Thallium	ND	0.0050								

<b>MBLK</b>		Sample ID: <b>MBLK-112942-112942</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/19/2018 02:07 PM</b>		
Client ID:		Run ID: <b>ICPMS3_180119A</b>				SeqNo: <b>4856850</b>		Prep Date: <b>1/16/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	ND	0.0050								
Lithium	ND	0.010								

<b>LCS</b>		Sample ID: <b>LCS-112942-112942</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/18/2018 08:30 PM</b>		
Client ID:		Run ID: <b>ICPMS3_180118A</b>				SeqNo: <b>4854230</b>		Prep Date: <b>1/16/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Antimony	0.09752	0.0050	0.1	0	97.5	80-120	0			
Arsenic	0.09723	0.0050	0.1	0	97.2	80-120	0			
Barium	0.0943	0.0050	0.1	0	94.3	80-120	0			
Beryllium	0.09434	0.0020	0.1	0	94.3	80-120	0			
Boron	0.4929	0.020	0.5	0	98.6	80-120	0			
Cadmium	0.09856	0.0020	0.1	0	98.6	80-120	0			
Calcium	9.939	0.50	10	0	99.4	80-120	0			
Chromium	0.09758	0.0050	0.1	0	97.6	80-120	0			
Cobalt	0.09937	0.0050	0.1	0	99.4	80-120	0			
Lead	0.09811	0.0050	0.1	0	98.1	80-120	0			
Molybdenum	0.1018	0.0050	0.1	0	102	80-120	0			
Selenium	0.09845	0.0050	0.1	0	98.4	80-120	0			
Thallium	0.09704	0.0050	0.1	0	97	80-120	0			

**Note:** See Qualifiers Page for a list of Qualifiers and their explanation.

**Client:** NTH Consultants, Ltd.  
**Work Order:** 1801438  
**Project:** Holland Board of Public Works (73-160017-04)

## QC BATCH REPORT

Batch ID: **112942** Instrument ID **ICPMS3** Method: **SW6020A**

<b>LCS</b>		Sample ID: <b>LCS-112942-112942</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/19/2018 02:08 PM</b>		
Client ID:		Run ID: <b>ICPMS3_180119A</b>				SeqNo: <b>4856851</b>		Prep Date: <b>1/16/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Lithium 0.1009 0.010 0.1 0 101 80-120 0

<b>MS</b>		Sample ID: <b>1801438-01AMS</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/18/2018 08:33 PM</b>		
Client ID: <b>MW-3</b>		Run ID: <b>ICPMS3_180118A</b>				SeqNo: <b>4854232</b>		Prep Date: <b>1/16/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Antimony 0.09538 0.0050 0.1 0.000005 95.4 75-125 0  
 Arsenic 0.1015 0.0050 0.1 0.000639 101 75-125 0  
 Beryllium 0.09179 0.0020 0.1 0.000158 91.6 75-125 0  
 Boron 1.254 0.020 0.5 0.786 93.7 75-125 0  
 Cadmium 0.09295 0.0020 0.1 -0.000002 93 75-125 0  
 Chromium 0.09466 0.0050 0.1 0.00012 94.5 75-125 0  
 Cobalt 0.09193 0.0050 0.1 0.000484 91.4 75-125 0  
 Lead 0.09866 0.0050 0.1 0.000081 98.6 75-125 0  
 Molybdenum 0.1011 0.0050 0.1 0.000361 101 75-125 0  
 Selenium 0.1045 0.0050 0.1 0.0001 104 75-125 0  
 Thallium 0.09835 0.0050 0.1 0.000066 98.3 75-125 0

<b>MS</b>		Sample ID: <b>1801438-01AMS</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/19/2018 02:16 PM</b>		
Client ID: <b>MW-3</b>		Run ID: <b>ICPMS3_180119A</b>				SeqNo: <b>4856856</b>		Prep Date: <b>1/16/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Barium 0.1339 0.0050 0.1 0.03424 99.7 75-125 0

<b>MS</b>		Sample ID: <b>1801438-01AMS</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/19/2018 02:21 PM</b>		
Client ID: <b>MW-3</b>		Run ID: <b>ICPMS3_180119A</b>				SeqNo: <b>4856859</b>		Prep Date: <b>1/16/2018</b>		DF: <b>10</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Calcium 330.3 5.0 10 316.7 136 75-125 0 SO

<b>MS</b>		Sample ID: <b>1801438-01AMS</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/22/2018 01:13 PM</b>		
Client ID: <b>MW-3</b>		Run ID: <b>ICPMS3_180122A</b>				SeqNo: <b>4858018</b>		Prep Date: <b>1/16/2018</b>		DF: <b>100</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Lithium 0.1095 1.0 0.1 0.01712 92.4 75-125 0 J

**Note:** See Qualifiers Page for a list of Qualifiers and their explanation.

**Client:** NTH Consultants, Ltd.  
**Work Order:** 1801438  
**Project:** Holland Board of Public Works (73-160017-04)

## QC BATCH REPORT

Batch ID: **112942**      Instrument ID **ICPMS3**      Method: **SW6020A**

MSD				Sample ID: <b>1801438-01AMSD</b>			Units: <b>mg/L</b>		Analysis Date: <b>1/18/2018 08:35 PM</b>	
Client ID: <b>MW-3</b>				Run ID: <b>ICPMS3_180118A</b>			SeqNo: <b>4854233</b>		Prep Date: <b>1/16/2018</b>	
									DF: <b>1</b>	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Antimony	0.09458	0.0050	0.1	0.000005	94.6	75-125	0.09538	0.837	20	
Arsenic	0.1015	0.0050	0.1	0.000639	101	75-125	0.1015	0.0394	20	
Beryllium	0.09152	0.0020	0.1	0.000158	91.4	75-125	0.09179	0.296	20	
Boron	1.264	0.020	0.5	0.786	95.6	75-125	1.254	0.776	20	
Cadmium	0.09283	0.0020	0.1	-0.000002	92.8	75-125	0.09295	0.131	20	
Chromium	0.09416	0.0050	0.1	0.00012	94	75-125	0.09466	0.532	20	
Cobalt	0.09169	0.0050	0.1	0.000484	91.2	75-125	0.09193	0.253	20	
Lead	0.0987	0.0050	0.1	0.000081	98.6	75-125	0.09866	0.0314	20	
Molybdenum	0.1008	0.0050	0.1	0.000361	100	75-125	0.1011	0.208	20	
Selenium	0.103	0.0050	0.1	0.0001	103	75-125	0.1045	1.43	20	
Thallium	0.09852	0.0050	0.1	0.000066	98.5	75-125	0.09835	0.18	20	

MSD				Sample ID: <b>1801438-01AMSD</b>			Units: <b>mg/L</b>		Analysis Date: <b>1/19/2018 02:18 PM</b>	
Client ID: <b>MW-3</b>				Run ID: <b>ICPMS3_180119A</b>			SeqNo: <b>4856857</b>		Prep Date: <b>1/16/2018</b>	
									DF: <b>1</b>	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	0.1343	0.0050	0.1	0.03424	100	75-125	0.1329	1	20	

MSD				Sample ID: <b>1801438-01AMSD</b>			Units: <b>mg/L</b>		Analysis Date: <b>1/19/2018 02:22 PM</b>	
Client ID: <b>MW-3</b>				Run ID: <b>ICPMS3_180119A</b>			SeqNo: <b>4856860</b>		Prep Date: <b>1/16/2018</b>	
									DF: <b>10</b>	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Calcium	323.2	5.0	10	316.7	65	75-125	330.3	2.18	20	SO

MSD				Sample ID: <b>1801438-01AMSD</b>			Units: <b>mg/L</b>		Analysis Date: <b>1/22/2018 01:14 PM</b>	
Client ID: <b>MW-3</b>				Run ID: <b>ICPMS3_180122A</b>			SeqNo: <b>4858019</b>		Prep Date: <b>1/16/2018</b>	
									DF: <b>100</b>	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Lithium	0.1117	1.0	0.1	0.01712	94.6	75-125	0.1095	0	20	J

The following samples were analyzed in this batch:

1801438-01A	1801438-02A	1801438-03A
1801438-04A	1801438-05A	1801438-06A
1801438-07A		

**Note:** See Qualifiers Page for a list of Qualifiers and their explanation.



**Client:** NTH Consultants, Ltd.  
**Work Order:** 1801438  
**Project:** Holland Board of Public Works (73-160017-04)

## QC BATCH REPORT

Batch ID: **112955**      Instrument ID **TDS**      Method: **A2540 C-11**

<b>MBLK</b>		Sample ID: <b>MBLK-112955-112955</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/17/2018 01:13 PM</b>		
Client ID:		Run ID: <b>TDS_180117A</b>				SeqNo: <b>4851445</b>		Prep Date: <b>1/17/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Total Dissolved Solids      ND      10

<b>LCS</b>		Sample ID: <b>LCS-112955-112955</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/17/2018 01:13 PM</b>		
Client ID:		Run ID: <b>TDS_180117A</b>				SeqNo: <b>4851444</b>		Prep Date: <b>1/17/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Total Dissolved Solids      481      10      495      0      97.2      80-120      0

<b>DUP</b>		Sample ID: <b>1801421-01A DUP</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/17/2018 01:13 PM</b>		
Client ID:		Run ID: <b>TDS_180117A</b>				SeqNo: <b>4851424</b>		Prep Date: <b>1/17/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Total Dissolved Solids      419      10      0      0      0      0-0      419      0      10

<b>DUP</b>		Sample ID: <b>1801421-02A DUP</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/17/2018 01:13 PM</b>		
Client ID:		Run ID: <b>TDS_180117A</b>				SeqNo: <b>4851426</b>		Prep Date: <b>1/17/2018</b>		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

Total Dissolved Solids      423      10      0      0      0      0-0      425      0.472      10

The following samples were analyzed in this batch:

1801438-01B	1801438-02B	1801438-03B
1801438-04B	1801438-05B	1801438-06B
1801438-07B		

**Note:** See Qualifiers Page for a list of Qualifiers and their explanation.

**Client:** NTH Consultants, Ltd.  
**Work Order:** 1801438  
**Project:** Holland Board of Public Works (73-160017-04)

## QC BATCH REPORT

Batch ID: **R228067** Instrument ID **WETCHEM** Method: **A4500-H B-11**

<b>LCS</b>		Sample ID: <b>WLCSW1-180112-R228067</b>				Units: <b>s.u.</b>		Analysis Date: <b>1/12/2018 02:20 PM</b>		
Client ID:		Run ID: <b>WETCHEM_180112F</b>				SeqNo: <b>4847053</b>		Prep Date:		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

pH (laboratory) 3.94 0.10 4 0 98.5 90-110 0

<b>DUP</b>		Sample ID: <b>1801284-01C DUP</b>				Units: <b>s.u.</b>		Analysis Date: <b>1/12/2018 02:20 PM</b>		
Client ID:		Run ID: <b>WETCHEM_180112F</b>				SeqNo: <b>4847055</b>		Prep Date:		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

pH (laboratory) 7.78 0.10 0 0 0 0-0 7.78 0 20

<b>DUP</b>		Sample ID: <b>1801438-01B DUP</b>				Units: <b>s.u.</b>		Analysis Date: <b>1/12/2018 02:20 PM</b>		
Client ID: <b>MW-3</b>		Run ID: <b>WETCHEM_180112F</b>				SeqNo: <b>4847060</b>		Prep Date:		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

pH (laboratory) 6.37 0.10 0 0 0 0-0 6.4 0.47 20

The following samples were analyzed in this batch:

1801438-01B	1801438-02B	1801438-03B
1801438-04B	1801438-05B	1801438-06B
1801438-07B		

**Note:** See Qualifiers Page for a list of Qualifiers and their explanation.

**Client:** NTH Consultants, Ltd.  
**Work Order:** 1801438  
**Project:** Holland Board of Public Works (73-160017-04)

## QC BATCH REPORT

Batch ID: **R228140** Instrument ID **IC3** Method: **E300.0**

<b>MBLK</b>		Sample ID: <b>CCB/MBLK-R228140</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/12/2018 10:27 AM</b>		
Client ID:		Run ID: <b>IC3_180112A</b>				SeqNo: <b>4848121</b>		Prep Date:		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	ND	1.0								
Fluoride	ND	0.10								
Sulfate	ND	1.0								

<b>LCS</b>		Sample ID: <b>LCS-R228140</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/12/2018 10:47 AM</b>		
Client ID:		Run ID: <b>IC3_180112A</b>				SeqNo: <b>4848122</b>		Prep Date:		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	9.565	1.0	10	0	95.7	90-110	0			
Fluoride	2.011	0.10	2	0	101	90-110	0			
Sulfate	9.821	1.0	10	0	98.2	90-110	0			

<b>MS</b>		Sample ID: <b>1801438-01B MS</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/12/2018 04:12 PM</b>		
Client ID: <b>MW-3</b>		Run ID: <b>IC3_180112A</b>				SeqNo: <b>4848139</b>		Prep Date:		DF: <b>250</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	2621	250	2500	201	96.8	80-120	0			
Fluoride	520.4	25	500	0	104	80-120	0			
Sulfate	3738	250	2500	1193	102	80-120	0			

<b>MSD</b>		Sample ID: <b>1801438-01B MSD</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/12/2018 04:31 PM</b>		
Client ID: <b>MW-3</b>		Run ID: <b>IC3_180112A</b>				SeqNo: <b>4848140</b>		Prep Date:		DF: <b>250</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	2621	250	2500	201	96.8	80-120	2621	0.0143	20	
Fluoride	520	25	500	0	104	80-120	520.4	0.0721	20	
Sulfate	3711	250	2500	1193	101	80-120	3738	0.705	20	

The following samples were analyzed in this batch:

1801438-01B	1801438-02B	1801438-03B
1801438-04B		

**Note:** See Qualifiers Page for a list of Qualifiers and their explanation.

**Client:** NTH Consultants, Ltd.  
**Work Order:** 1801438  
**Project:** Holland Board of Public Works (73-160017-04)

## QC BATCH REPORT

Batch ID: **R228227** Instrument ID **IC3** Method: **E300.0**

<b>MBLK</b>		Sample ID: <b>CCB/MBLK-R228227</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/15/2018 10:49 AM</b>		
Client ID:		Run ID: <b>IC3_180115A</b>				SeqNo: <b>4849873</b>		Prep Date:		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	ND	1.0								
Fluoride	ND	0.10								
Sulfate	ND	1.0								

<b>LCS</b>		Sample ID: <b>LCS-R228227</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/15/2018 11:08 AM</b>		
Client ID:		Run ID: <b>IC3_180115A</b>				SeqNo: <b>4849874</b>		Prep Date:		DF: <b>1</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	9.535	1.0	10	0	95.4	90-110	0			
Fluoride	1.949	0.10	2	0	97.4	90-110	0			
Sulfate	9.664	1.0	10	0	96.6	90-110	0			

<b>MS</b>		Sample ID: <b>1801512-01B MS</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/15/2018 02:59 PM</b>		
Client ID:		Run ID: <b>IC3_180115A</b>				SeqNo: <b>4849884</b>		Prep Date:		DF: <b>250</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	2465	250	2500	88.65	95.1	80-120	0			
Fluoride	504.4	25	500	0	101	80-120	0			
Sulfate	3348	250	2500	847.7	100	80-120	0			

<b>MSD</b>		Sample ID: <b>1801512-01B MSD</b>				Units: <b>mg/L</b>		Analysis Date: <b>1/15/2018 03:57 PM</b>		
Client ID:		Run ID: <b>IC3_180115A</b>				SeqNo: <b>4849887</b>		Prep Date:		DF: <b>250</b>
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	2467	250	2500	88.65	95.1	80-120	2465	0.076	20	
Fluoride	504.4	25	500	0	101	80-120	504.4	0.00496	20	
Sulfate	3340	250	2500	847.7	99.7	80-120	3348	0.256	20	

The following samples were analyzed in this batch:

1801438-05B	1801438-06B	1801438-07B
-------------	-------------	-------------

**Note:** See Qualifiers Page for a list of Qualifiers and their explanation.



Cincinnati, OH  
+1 513 733 5336

Fort Collins, CO  
+1 970 490 1511

Everett, WA  
+1 425 356 2600

Holland, MI  
+1 616 399 6070

# Chain of Custody Form

Page 1 of 1

COC ID: 47226

Houston, TX  
+1 281 530 5656

Middletown, PA  
+1 717 944 5541

Spring City, PA  
+1 610 948 4903

Salt Lake City, UT  
+1 801 266 7700

South Charleston, WV  
+1 304 356 3168

York, PA  
+1 717 505 5280

ALS Project Manager:

ALS Work Order #: 1801438

Customer Information		Project Information		Parameter/Method Request for Analysis												
Purchase Order		Project Name		A	Matrix											
Work Order		Project Number	73-160017-04	B	<del>11 Hg</del>											
Company Name	NTH Consultants, Ltd.	Bill To Company	NTH Consultants, Ltd.	C	Chloride, Fluoride, Sulfate											
Send Report To	Karen Okonta	Invoice Attn	Accounts Payable	D	pH											
Address	41780 Six Mile Road	Address	41780 Six Mile Road	E	TDS											
City/State/Zip	Northville, MI 48168	City/State/Zip	Northville, MI 48168	F	Radium 226 & 228											
Phone	(248) 682-2668	Phone	(248) 662-2668	G												
Fax	(248) 324-5305	Fax	(248) 324-5305	H												
e-Mail Address	KOKONTA@NTHCONSULTANTS.COM	e-Mail Address		I												
				J												

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	MW-3	1-10-18	1:50 P	GW	NITRIC	3											
2	MW-2	1-10-18	3:20 P	GW													
3	EQUIPMENT BLANK	1-10-18	3:30 P	DI													
4	FIELD BLANK	1-10-18	3:40 P	DI													
5	MW-1	1-10-18	4:25 P	GW													
6	PZ-1	1-10-18	4:50 P	GW													
7	MATRIX SPIKE	1-10-18	—	GW													
8	MATRIX SPIKE DUPLICATE	1-10-18	—	GW													
9	FIELD DUPLICATE	1-10-18	—	GW													
10																	

Sampler(s) Please Print & Sign PHILIP HEROUT		Shipment Method		Turnaround Time in Business Days (BD) <input type="checkbox"/> 10 BD <input type="checkbox"/> 5 BD <input type="checkbox"/> 3 BD <input type="checkbox"/> 2 BD <input type="checkbox"/> 1 BD				Other <input type="checkbox"/>		Results Due Date:	
Relinquished by:	Date: 1-10-18	Time: 5:21	Received by:	Notes:		Cooler ID: SR2		Cooler Temp: 1.2°C		QC Package: (Check One Box Below)	
Relinquished by:	Date:	Time:	Received by (Laboratory):							<input type="checkbox"/> Level II Std QC <input type="checkbox"/> TRRP Checklist <input type="checkbox"/> Level III Std QC/Raw Data <input type="checkbox"/> TRRP Level IV <input type="checkbox"/> Level IV SW846/CLP <input type="checkbox"/> Other	
Logged by (Laboratory): DES	Date: 1/11/18	Time: 0830	Checked by (Laboratory):								
Preservative Key: 1-HCl 2-HNO <sub>3</sub> 3-H <sub>2</sub> SO <sub>4</sub> 4-NaOH 5-Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> 6-NaHSO <sub>4</sub> 7-Other 8-4°C 9-5035											

Note: 1. Any changes must be made in writing once samples and COC Form have been submitted to ALS Environmental.  
 2. Unless otherwise agreed in a formal contract, services provided by ALS Environmental are expressly limited to the terms and conditions stated on the reverse.  
 3. The Chain of Custody is a legal document. All information must be completed accurately.

Copyright 2012 by ALS Environmental.

Sample Receipt Checklist

Client Name: **NTH - NORTHVILLE**

Date/Time Received: **10-Jan-18 17:21**

Work Order: **1801438**

Received by: **JG**

Checklist completed by Diane Shaw 11-Jan-18  
eSignature Date

Reviewed by: Chad Whelton 11-Jan-18  
eSignature Date

Matrices: **Groundwater**

Carrier name: **Client**

Shipping container/cooler in good condition?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Not Present <input type="checkbox"/>
Custody seals intact on shipping container/cooler?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Present <input checked="" type="checkbox"/>
Custody seals intact on sample bottles?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Present <input checked="" type="checkbox"/>
Chain of custody present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Chain of custody signed when relinquished and received?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Chain of custody agrees with sample labels?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Samples in proper container/bottle?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Sample containers intact?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Sufficient sample volume for indicated test?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
All samples received within holding time?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Container/Temp Blank temperature in compliance?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Sample(s) received on ice?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Temperature(s)/Thermometer(s):	<u>1.2/1.2 c</u>		<u>SR2</u>
Cooler(s)/Kit(s):	<u></u>		
Date/Time sample(s) sent to storage:	<u>1/11/2018 11:30:39 AM</u>		
Water - VOA vials have zero headspace?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	No VOA vials submitted <input checked="" type="checkbox"/>
Water - pH acceptable upon receipt?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	N/A <input type="checkbox"/>
pH adjusted?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>
pH adjusted by:	<u>-</u>		

Login Notes:

-----

Client Contacted:

Date Contacted:

Person Contacted:

Contacted By:

Regarding:

Comments:

CorrectiveAction:



09-Mar-2018

Karen Okonta  
NTH Consultants, Ltd.  
41780 Six Mile Road  
Northville, MI 48168

Re: **Holland Board of Public Works (73-160017-04)**

Work Order: **1801438**

Dear Karen,

ALS Environmental received 7 samples on 10-Jan-2018 05:21 PM for the analyses presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental - Holland and for only the analyses requested.

Sample results are compliant with industry accepted practices and Quality Control results achieved laboratory specifications. Any exceptions are noted in the Case Narrative, or noted with qualifiers in the report or QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained from ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

The total number of pages in this report is 28.

If you have any questions regarding this report, please feel free to contact me:

ADDRESS: 3352 128th Avenue, Holland, MI, USA  
PHONE: +1 (616) 399-6070 FAX: +1 (616) 399-6185

Sincerely,

A handwritten signature in black ink, appearing to read "Chad Whelton".

Electronically approved by: Chad Whelton

Chad Whelton  
Project Manager

## Report of Laboratory Analysis

Certificate No: MI: 0022

ALS GROUP USA, CORP Part of the ALS Laboratory Group A Campbell Brothers Limited Company

Environmental 

[www.alsglobal.com](http://www.alsglobal.com)

RIGHT SOLUTIONS RIGHT PARTNER

---

**Client:** NTH Consultants, Ltd.  
**Project:** Holland Board of Public Works (73-160017-04)  
**Work Order:** 1801438

**Work Order Sample Summary**

---

<u>Lab Samp ID</u>	<u>Client Sample ID</u>	<u>Matrix</u>	<u>Tag Number</u>	<u>Collection Date</u>	<u>Date Received</u>	<u>Hold</u>
1801438-01	MW-3	Groundwater		1/10/2018 13:50	1/10/2018 17:21	<input type="checkbox"/>
1801438-02	MW-2	Groundwater		1/10/2018 15:20	1/10/2018 17:21	<input type="checkbox"/>
1801438-03	Equipment Blank	Water		1/10/2018 15:30	1/10/2018 17:21	<input type="checkbox"/>
1801438-04	Field Blank	Water		1/10/2018 15:40	1/10/2018 17:21	<input type="checkbox"/>
1801438-05	MW-1	Groundwater		1/10/2018 16:25	1/10/2018 17:21	<input type="checkbox"/>
1801438-06	PZ-1	Groundwater		1/10/2018 16:50	1/10/2018 17:21	<input type="checkbox"/>
1801438-07	Field Duplicate	Groundwater		1/10/2018	1/10/2018 17:21	<input type="checkbox"/>



## ALS Group, USA

*Date: 09-Mar-18*

---

**Client:** NTH Consultants, Ltd.  
**Project:** Holland Board of Public Works (73-160017-04)  
**Work Order:** 1801438

---

## Case Narrative

Radium-226/228 analysis performed by ALS Fort Collins laboratory.

## ALS Group, USA

Date: 09-Mar-18

**Client:** NTH Consultants, Ltd.

**Project:** Holland Board of Public Works (73-160017-04)

**Work Order:** 1801438

**Sample ID:** MW-3

**Lab ID:** 1801438-01

**Collection Date:** 1/10/2018 01:50 PM

**Matrix:** GROUNDWATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>SUBCONTRACTED ANALYSES</b>			<b>SUBCONTRACT</b>			Analyst: <b>ALS</b>
Subcontracted Analyses	See attached			as noted	1	2/12/2018

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

## ALS Group, USA

Date: 09-Mar-18

**Client:** NTH Consultants, Ltd.

**Project:** Holland Board of Public Works (73-160017-04)

**Work Order:** 1801438

**Sample ID:** MW-2

**Lab ID:** 1801438-02

**Collection Date:** 1/10/2018 03:20 PM

**Matrix:** GROUNDWATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>SUBCONTRACTED ANALYSES</b>			<b>SUBCONTRACT</b>			Analyst: <b>ALS</b>
Subcontracted Analyses	See attached			as noted	1	2/12/2018

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

## ALS Group, USA

Date: 09-Mar-18

**Client:** NTH Consultants, Ltd.

**Project:** Holland Board of Public Works (73-160017-04)

**Work Order:** 1801438

**Sample ID:** Equipment Blank

**Lab ID:** 1801438-03

**Collection Date:** 1/10/2018 03:30 PM

**Matrix:** WATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>SUBCONTRACTED ANALYSES</b>			<b>SUBCONTRACT</b>			Analyst: <b>ALS</b>
Subcontracted Analyses	See attached			as noted	1	2/12/2018

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

## ALS Group, USA

Date: 09-Mar-18

**Client:** NTH Consultants, Ltd.

**Project:** Holland Board of Public Works (73-160017-04)

**Work Order:** 1801438

**Sample ID:** Field Blank

**Lab ID:** 1801438-04

**Collection Date:** 1/10/2018 03:40 PM

**Matrix:** WATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>SUBCONTRACTED ANALYSES</b>			<b>SUBCONTRACT</b>			Analyst: <b>ALS</b>
Subcontracted Analyses	See attached			as noted	1	2/12/2018

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

## ALS Group, USA

Date: 09-Mar-18

**Client:** NTH Consultants, Ltd.

**Project:** Holland Board of Public Works (73-160017-04)

**Work Order:** 1801438

**Sample ID:** MW-1

**Lab ID:** 1801438-05

**Collection Date:** 1/10/2018 04:25 PM

**Matrix:** GROUNDWATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>SUBCONTRACTED ANALYSES</b>			<b>SUBCONTRACT</b>			Analyst: <b>ALS</b>
Subcontracted Analyses	See attached			as noted	1	2/12/2018

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

## ALS Group, USA

Date: 09-Mar-18

**Client:** NTH Consultants, Ltd.

**Project:** Holland Board of Public Works (73-160017-04)

**Work Order:** 1801438

**Sample ID:** PZ-1

**Lab ID:** 1801438-06

**Collection Date:** 1/10/2018 04:50 PM

**Matrix:** GROUNDWATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>SUBCONTRACTED ANALYSES</b>			<b>SUBCONTRACT</b>			Analyst: <b>ALS</b>
Subcontracted Analyses	See attached			as noted	1	2/12/2018

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

## ALS Group, USA

Date: 09-Mar-18

**Client:** NTH Consultants, Ltd.

**Project:** Holland Board of Public Works (73-160017-04)

**Work Order:** 1801438

**Sample ID:** Field Duplicate

**Lab ID:** 1801438-07

**Collection Date:** 1/10/2018

**Matrix:** GROUNDWATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>SUBCONTRACTED ANALYSES</b>			<b>SUBCONTRACT</b>			Analyst: <b>ALS</b>
Subcontracted Analyses	See attached			as noted	1	2/12/2018

**Note:** See Qualifiers page for a list of qualifiers and their definitions.





Cincinnati, OH  
+1 513 733 5336

Fort Collins, CO  
+1 970 490 1511

Everett, WA  
+1 425 356 2600

Holland, MI  
+1 616 399 6070

# Chain of Custody Form

Page 1 of 1

COC ID: 47226

Houston, TX  
+1 281 530 5656

Spring City, PA  
+1 610 948 4903

Middletown, PA  
+1 717 944 5541

Salt Lake City, UT  
+1 801 266 7700

South Charleston, WV  
+1 304 356 3168

York, PA  
+1 717 505 5280

ALS Project Manager:

ALS Work Order #: 1801438

Customer Information		Project Information		Parameter/Method Request for Analysis												
Purchase Order		Project Name		A	Matrix											
Work Order		Project Number	73-160017-04	B	<del>11 Hg</del>											
Company Name	NTH Consultants, Ltd.	Bill To Company	NTH Consultants, Ltd.	C	Chloride, Fluoride, Sulfate											
Send Report To	Karen Okonta	Invoice Attn	Accounts Payable	D	pH											
Address	41780 Six Mile Road	Address	41780 Six Mile Road	E	TDS											
City/State/Zip	Northville, MI 48168	City/State/Zip	Northville, MI 48168	F	Radium 226 & 228											
Phone	(248) 682-2668	Phone	(248) 662-2668	G												
Fax	(248) 324-5305	Fax	(248) 324-5305	H												
e-Mail Address	KOKONTA@NTHCONSULTANTS.COM	e-Mail Address		I												
				J												

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	MW-3	1-10-18	1:50 P	GW	NITRIC	3											
2	MW-2	1-10-18	3:20 P	GW													
3	EQUIPMENT BLANK	1-10-18	3:30 P	DI													
4	FIELD BLANK	1-10-18	3:40 P	DI													
5	MW-1	1-10-18	4:25 P	GW													
6	PZ-1	1-10-18	4:50 P	GW													
7	MATRIX SPIKE	1-10-18	—	GW													
8	MATRIX SPIKE DUPLICATE	1-10-18	—	GW													
9	FIELD DUPLICATE	1-10-18	—	GW													
10																	

Sampler(s) Please Print & Sign PHILIP HEROUT		Shipment Method		Turnaround Time in Business Days (BD) <input type="checkbox"/> 10 BD <input type="checkbox"/> 5 BD <input type="checkbox"/> 3 BD <input type="checkbox"/> 2 BD <input type="checkbox"/> 1 BD				Other <input type="checkbox"/>		Results Due Date:	
Relinquished by:	Date: 1-10-18	Time: 5:21	Received by:	Notes:		Cooler ID: SR2		Cooler Temp: 1.2°C		QC Package: (Check One Box Below)	
Relinquished by:	Date:	Time:	Received by (Laboratory):							<input type="checkbox"/> Level II Std QC <input type="checkbox"/> TRRP Checklist <input type="checkbox"/> Level III Std QC/Raw Data <input type="checkbox"/> TRRP Level IV <input type="checkbox"/> Level IV SW846/CLP <input type="checkbox"/> Other	
Logged by (Laboratory): DES	Date: 1/11/18	Time: 0830	Checked by (Laboratory):								
Preservative Key: 1-HCl 2-HNO <sub>3</sub> 3-H <sub>2</sub> SO <sub>4</sub> 4-NaOH 5-Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> 6-NaHSO <sub>4</sub> 7-Other 8-4°C 9-5035											

Note: 1. Any changes must be made in writing once samples and COC Form have been submitted to ALS Environmental.  
2. Unless otherwise agreed in a formal contract, services provided by ALS Environmental are expressly limited to the terms and conditions stated on the reverse.  
3. The Chain of Custody is a legal document. All information must be completed accurately.

Copyright 2012 by ALS Environmental.



Wednesday, February 07, 2018

Chad Whelton  
ALS Environmental  
3352 128th Avenue  
Holland, MI 49424

Re: ALS Workorder: 1801141  
Project Name:  
Project Number: 1801438

Dear Mr. Whelton:

Seven water samples were received from ALS Environmental, on 1/12/2018. The samples were scheduled for the following analyses:

Radium-226

Radium-228

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental  
Jeff R. Kujawa  
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

ALS Environmental – Fort Collins	
Accreditation Body	License or Certification Number
AIHA	214884
Alaska (AK)	UST-086
Alaska (AK)	CO01099
Arizona (AZ)	AZ0742
California (CA)	06251CA
Colorado (CO)	CO01099
Connecticut (CT)	PH-0232
Florida (FL)	E87914
Idaho (ID)	CO01099
Kansas (KS)	E-10381
Kentucky (KY)	90137
L-A-B (DoD ELAP/ISO 170250)	L2257
Louisiana (LA)	05057
Maryland (MD)	285
Missouri (MO)	175
Nebraska(NE)	NE-OS-24-13
Nevada (NV)	CO000782008A
New York (NY)	12036
North Dakota (ND)	R-057
Oklahoma (OK)	1301
Pennsylvania (PA)	68-03116
Tennessee (TN)	2976
Texas (TX)	T104704241
Utah (UT)	CO01099
Washington (WA)	C1280



# 1801141

## **Radium-228:**

The samples were analyzed for the presence of  $^{228}\text{Ra}$  by low background gas flow proportional counting of  $^{228}\text{Ac}$ , which is the ingrown progeny of  $^{228}\text{Ra}$ , according to the current revision of SOP 724.

All acceptance criteria were met.

## **Radium-226:**

The samples were prepared and analyzed according to the current revision of SOP 783.

All acceptance criteria were met.

# ALS -- Fort Collins

## Sample Number(s) Cross-Reference Table

---

**OrderNum:** 1801141

**Client Name:** ALS Environmental

**Client Project Name:**

**Client Project Number:** 1801438

**Client PO Number:** 20-1801438

---

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
MW-2	1801141-1		WATER	10-Jan-18	15:20
Equipment Blank	1801141-2		WATER	10-Jan-18	15:30
Field Blank	1801141-3		WATER	10-Jan-18	15:40
MW-1	1801141-4		WATER	10-Jan-18	16:25
PZ-1	1801141-5		WATER	10-Jan-18	16:50
Field Duplicate	1801141-6		WATER	10-Jan-18	
MW-3	1801141-7		WATER	10-Jan-18	13:50

**Subcontractor:**ALS Environmental, Fort Collins  
225 Commerce Dr.

TEL: (800) 443-1511

FAX:

Fort Collins, CO 80524

Acct #:

**CHAIN-OF-CUSTODY RECORD**

Page 1 of 1

Date: **11-Jan-18**COC ID: **8433**Due D **09-Feb-18****Salesperson** **Brian Root**

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order		Project Name	1801438	A	Subcontracted Analyses (SUBCONTRACT) <i>Radium 226/228</i>
Work Order		Project Number		B	<i>MS/MSD</i>
Company Name	ALS Group USA, Corp	Bill To Company	ALS Group USA, Corp	C	
Send Report To	Chad Whelton	Inv Attn	Accounts Payable	D	
Address	3352 128th Ave	Address	3352 128th Ave	E	
				F	
City/State/Zip	Holland, Michigan 49424	City/State/Zip	Holland, Michigan 49424	G	
Phone	(616) 399-6070	Phone	(616) 399-6070	H	
Fax	(616) 399-6185	Fax	(616) 399-6185	I	
eMail Address	chad.whelton@alsglobal.com	eMail CC		J	

ALS Sample ID	Client Sample ID	Matrix	Collection Date 24hr	Bottle	A	B	C	D	E	F	G	H	I	J
1 1801438-02C	MW-2	Groundwater	10/Jan/2018 15:20	(1) 1LPHNO3	X									
2 1801438-03C	Equipment Blank	Water	10/Jan/2018 15:30	(1) 1LPHNO3	X									
3 1801438-04C	Field Blank	Water	10/Jan/2018 15:40	(1) 1LPHNO3	X									
4 1801438-05C	MW-1	Groundwater	10/Jan/2018 16:25	(1) 1LPHNO3	X									
5 1801438-06C	PZ-1	Groundwater	10/Jan/2018 16:50	(1) 1LPHNO3	X									
6 1801438-07C	Field Duplicate	Groundwater	10/Jan/2018	(1) 1LPHNO3	X									
7 1801438-01C	MW-3	Groundwater	10/Jan/2018 13:50	(3) 1LPHNO3	X	X								

**Comments:**

Please analyze these samples per our instructions and indicated turnaround requirements. Please include all QC with data. The samples do not need to be returned and can be disposed after 30 days.

Relinquished by:	Date/Time: 1-11-18 1500	Received by: C Jumbh	Date/Time: 1-12-18 1030	Cooler IDs	Report/QC Level
Relinquished by:	Date/Time:	Received by:	Date/Time:		Std



ALS Environmental - Fort Collins  
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: ALS - Holland

Workorder No: 1801141

Project Manager: \_\_\_\_\_

Initials: CR Date: 1-12-18

1. Does this project require any special handling in addition to standard ALS procedures?		YES	<u>NO</u>
2. Are custody seals on shipping containers intact?	<u>NONE</u>	YES	NO
3. Are Custody seals on sample containers intact?	<u>NONE</u>	YES	NO
4. Is there a COC (Chain-of-Custody) present or other representative documents?		<u>YES</u>	NO
5. Are the COC and bottle labels complete and legible?		<u>YES</u>	NO
6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		<u>YES</u>	NO
7. Were airbills / shipping documents present and/or removable?	DROP OFF	<u>YES</u>	NO
8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	N/A	<u>YES</u>	NO
9. Are all aqueous non-preserved samples pH 4-9?	<u>N/A</u>	YES	NO
10. Is there sufficient sample for the requested analyses?		<u>YES</u>	NO
11. Were all samples placed in the proper containers for the requested analyses?		<u>YES</u>	NO
12. Are all samples within holding times for the requested analyses?		<u>YES</u>	NO
13. Were all sample containers received intact? (not broken or leaking, etc.)		<u>YES</u>	NO
14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____ > green pea	<u>N/A</u>	YES	NO
15. Do any water samples contain sediment? Amount Amount of sediment: ____ dusting ____ moderate ____ heavy	N/A	YES	NO
16. Were the samples shipped on ice?		YES	<u>NO</u>
17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #2 #4	<u>RAD ONLY</u>	YES	<u>NO</u>
Cooler #: <u>1</u>			
Temperature (°C): <u>Amb</u>			
No. of custody seals on cooler: <u>0</u>			
External µR/hr reading: <u>10</u>			
Background µR/hr reading: <u>10</u>			
Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? <u>YES</u> / NO / NA (If no, see Form 008.)			

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? YES / NO / CA Contact: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Project Manager Signature / Date: [Signature] 1-16-18

7 of 17



Client: ALS Environmental

Date: 07-Feb-18

Project: 1801438

Work Order: 1801141

Sample ID: MW-2

Lab ID: 1801141-1

Legal Location:

Matrix: WATER

Collection Date: 1/10/2018 15:20

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>Radium-226 by Radon Emanation - Method 903.1</b>						
Ra-226	ND (+/- 0.13)	U	0.24	pCi/l	NA	2/6/2018 13:43
Carr: BARIUM	91.6		40-110	%REC	DL = NA	2/6/2018 13:43
<b>Radium-228 Analysis by GFPC</b>						
Ra-228	ND (+/- 0.4)	U	0.91	pCi/l	NA	1/26/2018 09:05
Carr: BARIUM	96.8		40-110	%REC	DL = NA	1/26/2018 09:05

Client: ALS Environmental

Date: 07-Feb-18

Project: 1801438

Work Order: 1801141

Sample ID: Equipment Blank

Lab ID: 1801141-2

Legal Location:

Matrix: WATER

Collection Date: 1/10/2018 15:30

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>Radium-226 by Radon Emanation - Method 903.1</b>						
Ra-226	0.43 (+/- 0.21)		PAI 783		Prep Date: 1/26/2018	PrepBy: SKC
Carr: BARIUM	91.8		0.2	pCi/l	NA	2/6/2018 13:43
			40-110	%REC	DL = NA	2/6/2018 13:43
<b>Radium-228 Analysis by GFPC</b>						
Ra-228	ND (+/- 0.49)	U	PAI 724		Prep Date: 1/22/2018	PrepBy: ARS
Carr: BARIUM	92.4		0.93	pCi/l	NA	1/26/2018 09:05
			40-110	%REC	DL = NA	1/26/2018 09:05

Client: ALS Environmental

Date: 07-Feb-18

Project: 1801438

Work Order: 1801141

Sample ID: Field Blank

Lab ID: 1801141-3

Legal Location:

Matrix: WATER

Collection Date: 1/10/2018 15:40

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>Radium-226 by Radon Emanation - Method 903.1</b>						
			<b>PAI 783</b>		Prep Date: <b>1/26/2018</b>	PrepBy: <b>SKC</b>
Ra-226	0.23 (+/- 0.16)		0.19	pCi/l	NA	2/6/2018 13:43
Carr: BARIUM	93.6		40-110	%REC	DL = NA	2/6/2018 13:43
<b>Radium-228 Analysis by GFPC</b>						
			<b>PAI 724</b>		Prep Date: <b>1/22/2018</b>	PrepBy: <b>ARS</b>
Ra-228	ND (+/- 0.39)	U	0.89	pCi/l	NA	1/26/2018 09:05
Carr: BARIUM	97.3		40-110	%REC	DL = NA	1/26/2018 09:05

Client: ALS Environmental

Date: 07-Feb-18

Project: 1801438

Work Order: 1801141

Sample ID: MW-1

Lab ID: 1801141-4

Legal Location:

Matrix: WATER

Collection Date: 1/10/2018 16:25

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>Radium-226 by Radon Emanation - Method 903.1</b>						
			<b>PAI 783</b>		Prep Date: <b>1/26/2018</b>	PrepBy: <b>SKC</b>
Ra-226	ND (+/- 0.13)	U	0.22	pCi/l	NA	2/6/2018 13:43
Carr: BARIUM	91		40-110	%REC	DL = NA	2/6/2018 13:43
<b>Radium-228 Analysis by GFPC</b>						
			<b>PAI 724</b>		Prep Date: <b>1/22/2018</b>	PrepBy: <b>ARS</b>
Ra-228	ND (+/- 0.42)	U	0.96	pCi/l	NA	1/26/2018 09:05
Carr: BARIUM	94.8		40-110	%REC	DL = NA	1/26/2018 09:05

Client: ALS Environmental

Date: 07-Feb-18

Project: 1801438

Work Order: 1801141

Sample ID: PZ-1

Lab ID: 1801141-5

Legal Location:

Matrix: WATER

Collection Date: 1/10/2018 16:50

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>Radium-226 by Radon Emanation - Method 903.1</b>						
Ra-226	0.63 (+/- 0.27)		PAI 783	0.2 pCi/l	NA	Prep Date: 1/26/2018 PrepBy: SKC 2/6/2018 14:15
Carr: BARIUM	90.7		40-110	%REC	DL = NA	2/6/2018 14:15
<b>Radium-228 Analysis by GFPC</b>						
Ra-228	ND (+/- 0.48)	U	PAI 724	0.9 pCi/l	NA	Prep Date: 1/22/2018 PrepBy: ARS 1/26/2018 09:05
Carr: BARIUM	95.2		40-110	%REC	DL = NA	1/26/2018 09:05

Client: ALS Environmental

Date: 07-Feb-18

Project: 1801438

Work Order: 1801141

Sample ID: Field Duplicate

Lab ID: 1801141-6

Legal Location:

Matrix: WATER

Collection Date: 1/10/2018

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>Radium-226 by Radon Emanation - Method 903.1</b>						
			<b>PAI 783</b>		Prep Date: <b>1/26/2018</b>	PrepBy: <b>SKC</b>
Ra-226	ND (+/- 0.17)	U	0.24	pCi/l	NA	2/6/2018 14:15
Carr: BARIUM	86.3		40-110	%REC	DL = NA	2/6/2018 14:15
<b>Radium-228 Analysis by GFPC</b>						
			<b>PAI 724</b>		Prep Date: <b>1/22/2018</b>	PrepBy: <b>ARS</b>
Ra-228	ND (+/- 0.47)	U,M	1.01	pCi/l	NA	1/26/2018 09:05
Carr: BARIUM	89.5		40-110	%REC	DL = NA	1/26/2018 09:05

Client: ALS Environmental

Date: 07-Feb-18

Project: 1801438

Work Order: 1801141

Sample ID: MW-3

Lab ID: 1801141-7

Legal Location:

Matrix: WATER

Collection Date: 1/10/2018 13:50

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
<b>Radium-226 by Radon Emanation - Method 903.1</b>						
			<b>PAI 783</b>		Prep Date: <b>1/26/2018</b>	PrepBy: <b>SKC</b>
Ra-226	0.46 (+/- 0.18)		0.07	pCi/l	NA	2/6/2018 14:15
Carr: BARIUM	92.9		40-110	%REC	DL = NA	2/6/2018 14:15
<b>Radium-228 Analysis by GFPC</b>						
			<b>PAI 724</b>		Prep Date: <b>1/22/2018</b>	PrepBy: <b>ARS</b>
Ra-228	0.73 (+/- 0.36)		0.61	pCi/l	NA	1/26/2018 09:05
Carr: BARIUM	95.5		40-110	%REC	DL = NA	1/26/2018 09:05

Client: ALS Environmental

Date: 07-Feb-18

Project: 1801438

Work Order: 1801141

Sample ID: MW-3

Lab ID: 1801141-7

Legal Location:

Matrix: WATER

Collection Date: 1/10/2018 13:50

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
----------	--------	------	--------------	-------	-----------------	---------------

**Explanation of Qualifiers****Radiochemistry:**

U or ND - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

\* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.

# - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

G - Sample density differs by more than 15% of LCS density.

D - DER is greater than Control Limit

M - Requested MDC not met.

LT - Result is less than requested MDC but greater than achieved MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

**Inorganics:**

B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).

U or ND - Indicates that the compound was analyzed for but not detected.

E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.

M - Duplicate injection precision was not met.

N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.

Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.

\* - Duplicate analysis (relative percent difference) not within control limits.

S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

**Organics:**

U or ND - Indicates that the compound was analyzed for but not detected.

B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.

E - Analyte concentration exceeds the upper level of the calibration range.

J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).

A - A tentatively identified compound is a suspected aldol-condensation product.

X - The analyte was diluted below an accurate quantitation level.

\* - The spike recovery is equal to or outside the control criteria used.

+ - The relative percent difference (RPD) equals or exceeds the control criteria.

G - A pattern resembling gasoline was detected in this sample.

D - A pattern resembling diesel was detected in this sample.

M - A pattern resembling motor oil was detected in this sample.

C - A pattern resembling crude oil was detected in this sample.

4 - A pattern resembling JP-4 was detected in this sample.

5 - A pattern resembling JP-5 was detected in this sample.

H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.

L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.

Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:

- gasoline
- JP-8
- diesel
- mineral spirits
- motor oil
- Stoddard solvent
- bunker C



## ALS -- Fort Collins

Date: 2/7/2018 2:37:3

Client: ALS Environmental

## QC BATCH REPORT

Work Order: 1801141

Project: 1801438

Batch ID: RE180126-1-1

Instrument ID Alpha Scin

Method: Radium-226 by Radon Emanation

DUP	Sample ID: 1801141-7				Units: pCi/l		Analysis Date: 2/6/2018 14:15				
Client ID: MW-3		Run ID: RE180126-1A				Prep Date: 1/26/2018			DF: NA		
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	0.26 (+/- 0.13)	0.14						0.46	0.9	2.1	LT
Carr: BARIUM	28760		31260		92	40-110		29120			

LCS	Sample ID: RE180126-1				Units: pCi/l		Analysis Date: 2/6/2018 14:15				
Client ID:	Run ID: RE180126-1A				Prep Date: 1/26/2018			DF: NA			
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	36.6 (+/- 9)	0.2	30.89		118	67-120					P
Carr: BARIUM	26160		31060		84.2	40-110					

LCSD	Sample ID: RE180126-1				Units: pCi/l		Analysis Date: 2/6/2018 14:15				
Client ID:	Run ID: RE180126-1A				Prep Date: 1/26/2018			DF: NA			
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	34.1 (+/- 8.4)	0.1	30.89		110	67-120		36.6	0.2	2.1	P
Carr: BARIUM	26740		31070		86.1	40-110		26160			

MB	Sample ID: RE180126-1				Units: pCi/l			Analysis Date: 2/6/2018 14:15			
Client ID:	Run ID: RE180126-1A				Prep Date: 1/26/2018			DF: NA			
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	ND	0.103									U
Carr: BARIUM	29080		31060		93.6	40-110					

The following samples were analyzed in this batch:

1801141-1	1801141-2	1801141-3
1801141-4	1801141-5	1801141-7

Client: ALS Environmental  
 Work Order: 1801141  
 Project: 1801438

## QC BATCH REPORT

Batch ID: **RA180122-1-3** Instrument ID **LB4100-c** Method: **Radium-228 Analysis by GFPC**

DUP	Sample ID: 1801141-7				Units: pCi/l		Analysis Date: 1/26/2018 09:05				
Client ID: MW-3		Run ID: RA180122-1A				Prep Date: 1/22/2018			DF: NA		
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-228	ND	0.6						0.73	0.4	2.1	U
Carr: BARIUM	30430		32030		95	40-110		30690			

LCS	Sample ID: RA180122-1				Units: pCi/l		Analysis Date: 1/26/2018 08:52				
Client ID:	Run ID: RA180122-1A				Prep Date: 1/22/2018			DF: NA			
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-228	4.6 (+/- 1.4)	1.1	6.358		73.1	70-130					P,M3
Carr: BARIUM	30790		31830		96.7	40-110					

LCSD	Sample ID: RA180122-1				Units: pCi/l		Analysis Date: 1/26/2018 08:52				
Client ID:	Run ID: RA180122-1A				Prep Date: 1/22/2018			DF: NA			
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-228	6.6 (+/- 1.8)	1.1	6.358		103	70-130		4.6	0.9	2.1	P,M3
Carr: BARIUM	30840		31840		96.9	40-110		30790			

MB	Sample ID: RA180122-1				Units: pCi/l			Analysis Date: 1/26/2018 09:16			
Client ID:	Run ID: RA180122-1A				Prep Date: 1/22/2018			DF: NA			
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-228	ND	0.65									U
Carr: BARIUM	31240		31840		98.1	40-110					

The following samples were analyzed in this batch:

1801141-1	1801141-2	1801141-3
1801141-4	1801141-5	1801141-6
1801141-7		



## GROUNDWATER SAMPLE COLLECTION LOG

### GENERAL INFORMATION

Project Name: JDY PP HOLLAND BFW Date: 01-10-2018  
Project #: 73-160017-04 Field Personnel: P. HEROUT  
Site Location: HOLLAND MI Well Const.: SCH 40 PVC  
Well ID: MW-1 Casing Diameter: 2.0"  
Sample ID: MW-1 Screened Interval: 9.0'-14.0' Bas  
(ft. from TOC) (12.0' - 17.0')

### PURGING DATA

Time: 10:50 Start: 10:50 Finish: 12:50

Purging Volume	Casing Diameter (in)	Casing Vol. Gal./Ft.	3 Casing Vol. Gal./Ft.
Depth to Water (ft. from TOC) = <u>6.6</u>	1.5	0.10	0.30
Total Well Depth (ft. from TOC) = <u>16.93</u>	2	0.16	0.48
Height of Water in Well (ft.) = <u>10.33</u>	3	0.36	1.08
One Well Volume (gallons) = <u>1.65</u>	4	0.63	1.89

Gallons Purged: ≈ 5.0 (4.95) Purging Method: PERISTALTIC  
Well Volumes Purged: 3 Purging Rate (gal./min.) 0.25  
Was Well Purged Dry? Yes ~ No ~

### FIELD MONITORING PARAMETERS

Accum. Volume Purged (gal)	<u>≈ 1.2 gal</u> <u>4:00 PM</u>	<u>1.25 gal</u> <u>4:05 PM</u>	<u>2.5 gal</u> <u>4:10 PM</u>	<u>3.75 gal</u> <u>4:15 PM</u>	<u>5.0 gal</u> <u>4:20 PM</u>	FINAL SAMPLE <sup>4:25</sup>
pH (STU)	<u>6.83</u>	<u>6.81</u>	<u>6.82</u>	<u>6.83</u>	<u>6.84</u>	<u>6.83</u>
Temperature (C)	<u>6.9</u>	<u>6.8</u>	<u>6.9</u>	<u>6.9</u>	<u>6.8</u>	<u>6.8</u>
Conductivity (umhos)	<u>1899</u>	<u>1906</u>	<u>1894</u>	<u>1906</u>	<u>1896</u>	<u>1898</u>
ORP (mv)	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>
Dissolved Oxygen (ppm)	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>
Appearance/Color	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>
Odor	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>
Turbidity (NTu)	<u>2.3</u>	<u>5.4</u>	<u>7.3</u>	<u>11.4</u>	<u>15.7</u>	<u>16.3</u>

### SAMPLING DATA

Time: Start: 4:25 Finish: 4:30

Sample Collection Device: PERISTALTIC

Pump Rate (gpm): 0.2 Packer Used? Yes ~ No ~

Sample Collection Depth (ft. from TOC): ≈ 12.0 FT

Weather Conditions: OVERCAST / RAIN / SNOW Air Temperature (F): 26-38°F  
Wind Speed/Direction: 0-10 MPH  
Other: NA



## GROUNDWATER SAMPLE COLLECTION LOG

### GENERAL INFORMATION

Project Name: JDY PP HOLLAND BPW Date: 01-10-2019  
Project #: 73-160017-04 Field Personnel: P. HEROUT  
Site Location: HOLLAND, MI Well Const.: SCH 40 PVC  
Well ID: MW-2 Casing Diameter: 2.0"  
Sample ID: MW-2 Screened Interval: 8.0'-13.0' BGS  
(ft. from TOC) (14.0' - 19.0')

### PURGING DATA

Time:	Start: <u>2:30</u>	Finish: <u>3:15</u>	
Purging Volume	Casing Diameter (in)	Casing Vol. Gal./Ft.	3 Casing Vol. Gal./Ft.
Depth to Water (ft. from TOC) = <u>4.4</u>	1.5	0.10	0.30
Total Well Depth (ft. from TOC) = <u>16.2</u>	2	0.16	0.48
Height of Water in Well (ft.) = <u>11.8</u>	3	0.36	1.08
One Well Volume (gallons) = <u>1.88</u>	4	0.63	1.89
Gallons Purged: <u>~5.70 (5.66)</u>	Purging Method: <u>PERISTALTIC</u>		
Well Volumes Purged: <u>3</u>	Purging Rate (gal./min.) <u>0.13</u>		
Was Well Purged Dry? Yes ~ <u>No</u>			

### FIELD MONITORING PARAMETERS

Accum. Volume Purged (gal)	<u>2:30 0</u>	<u>0.65</u>	<u>1.3</u>	<u>1.95</u>	<u>2.6</u>	FINAL <u>5.8</u>
pH (STU)	<u>6.95</u>	<u>6.97</u>	<u>6.97</u>	<u>6.96</u>	<u>6.95</u>	<u>6.98</u>
Temperature (C)	<u>7.6</u>	<u>7.5</u>	<u>7.6</u>	<u>7.7</u>	<u>7.8</u>	<u>8.1</u>
Conductivity (umhos)	<u>2560</u>	<u>2559</u>	<u>2562</u>	<u>2560</u>	<u>2558</u>	<u>2557</u>
ORP (mv)	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>
Dissolved Oxygen (ppm)	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>
Appearance/Color	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>
Odor	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>
Turbidity (NTu)	<u>50</u>	<u>54</u>	<u>130</u>	<u>180</u>	<u>204</u>	<u>310</u>

### SAMPLING DATA

Time:	Start: <u>3:20</u>	Finish: <u>3:25</u>
Sample Collection Device: <u>PERISTALTIC</u>		
Pump Rate (gpm): <u>0.23</u>	Packer Used? Yes ~ No ~	
Sample Collection Depth (ft. from TOC): <u>13 FT</u>		
Weather Conditions: <u>OVERCAST / RAIN / SNOW</u>	Air Temperature (F): <u>26-38°F</u>	
	Wind Speed/Direction: <u>0-10 mph S</u>	
	Other: <u>NA</u>	



# GROUNDWATER SAMPLE COLLECTION LOG

## GENERAL INFORMATION

Project Name: JDY PP HOLLAND BPW Date: 01-10-2013  
 Project #: 73-160017-04 Field Personnel: P. HEROUT  
 Site Location: HOLLAND, MI Well Const.: SCH 40 PVC  
 Well ID: MW-3 Casing Diameter: 2.0"  
 Sample ID: MW-3 Screened Interval: 10.0'-15.0' BGS  
 (ft. from TOC) (13.0'-18.0')

## PURGING DATA

Time: 40 min Start: 1:00 Finish: 1:40

Purging Volume	Casing Diameter (in)	Casing Vol. Gal./Ft.	3 Casing Vol. Gal./Ft.
Depth to Water (ft. from TOC) = <u>4.8'</u>	<u>1.5</u>	<u>0.10</u>	<u>0.30</u>
Total Well Depth (ft. from TOC) = <u>18.2'</u>	<u>2</u>	<u>0.16</u>	<u>0.48</u>
Height of Water in Well (ft.) = <u>13.4'</u>	<u>3</u>	<u>0.36</u>	<u>1.08</u>
One Well Volume (gallons) = <u>2.14</u>	<u>4</u>	<u>0.63</u>	<u>1.89</u>

Gallons Purged: ≈ 6.5 (6.43) Purging Method: PERISTALTIC  
 Well Volumes Purged: 3 Purging Rate (gal./min.) 0.16  
 Was Well Purged Dry? Yes ~ No

## FIELD MONITORING PARAMETERS

Accum. Volume Purged (gal)	1:07	1:12	1:17	1:22	1:27	FINAL SAMPLE 1:40
pH (STU)	6.19	6.18	6.17	6.16	6.15	6.14
Temperature (C)	10.5	10.6	10.6	10.8	10.8	10.8
Conductivity (umhos)	3131	3130	3130	3133	3132	3135
ORP (mv)	—	—	—	—	—	—
Dissolved Oxygen (ppm)	—	—	—	—	—	—
Appearance/Color	—	—	—	—	—	—
Odor	—	—	—	—	—	—
Turbidity (NTu)	100	86	70	63	55	48

## SAMPLING DATA

Time: Start: 1:40 Finish: 1:55

Sample Collection Device: \_\_\_\_\_

Pump Rate (gpm): 0.15 Packer Used? Yes ~ No ~

Sample Collection Depth (ft. from TOC): ≈ 15.0'

Weather Conditions: OVERCAST / RAIN / SNOW Air Temperature (F): 26-33°F  
 Wind Speed/Direction: 0-10 MPH S  
 Other: NA



## GROUNDWATER SAMPLE COLLECTION LOG

### GENERAL INFORMATION

Project Name: JDY RP HOLLAND BPW Date: 01-10-2018  
Project #: 73-160017-04 Field Personnel: P. HEROUT  
Site Location: HOLLAND ME Well Const.: PVC  
Well ID: PZ-1 Casing Diameter: 2"  
Sample ID: PZ-1 Screened Interval: Bottom, NA  
(ft. from TOC) NA

### PURGING DATA

Time:	Start:	Finish:		
Purging Volume		Casing Diameter (in)	Casing Vol. Gal./Ft.	3 Casing Vol. Gal./Ft.
Depth to Water (ft. from TOC) = 10.3		1.5	0.10	0.30
Total Well Depth (ft. from TOC) = 13.6		2	0.16	0.48
Height of Water in Well (ft.) = 3.3		3	0.36	1.08
One Well Volume (gallons) = 0.528		4	0.63	1.89
Gallons Purged: 1.6 (1.58)		Purging Method: PERISTALTIC		
Well Volumes Purged: 3		Purging Rate (gal./min.) 0.13		
Was Well Purged Dry? Yes ~ No ~		DRAW DOWN EXCEEDED PLAN LOW FLOW EXCEEDED DRAW-DOWN PURGE 3 VOL, RETURN IN PM. SPECS. → 3X, RETURN TO SAMPLE		

### FIELD MONITORING PARAMETERS

Accum. Volume Purged (gal)	<u>0.5 gal</u>	<u>1.5 gal</u>				FINAL SAMPLE
pH (STU)	<u>8.2</u>	<u>8.2</u>				
Temperature (C)	<u>5.7</u>	<u>10.2</u>				
Conductivity (umhos)	<u>1876</u>	<u>1938</u>				
ORP (mv)						
Dissolved Oxygen (ppm)						
Appearance/Color						
Odor						
Turbidity (NTu)	<u>9.7</u>	<u>30.9</u>				

### SAMPLING DATA

Time: Start: 4:40 Finish: 4:50  
Sample Collection Device: PERISTALTIC  
Pump Rate (gpm): 0.25 ± Packer Used? Yes ~ No ~  
Sample Collection Depth (ft. from TOC): ≈ 11.5 FT RAS  
Weather Conditions: OVERCAST/RAIN/SNOW Air Temperature (F): 26-38°F  
Wind Speed/Direction: 0-10 mph S  
Other: NA